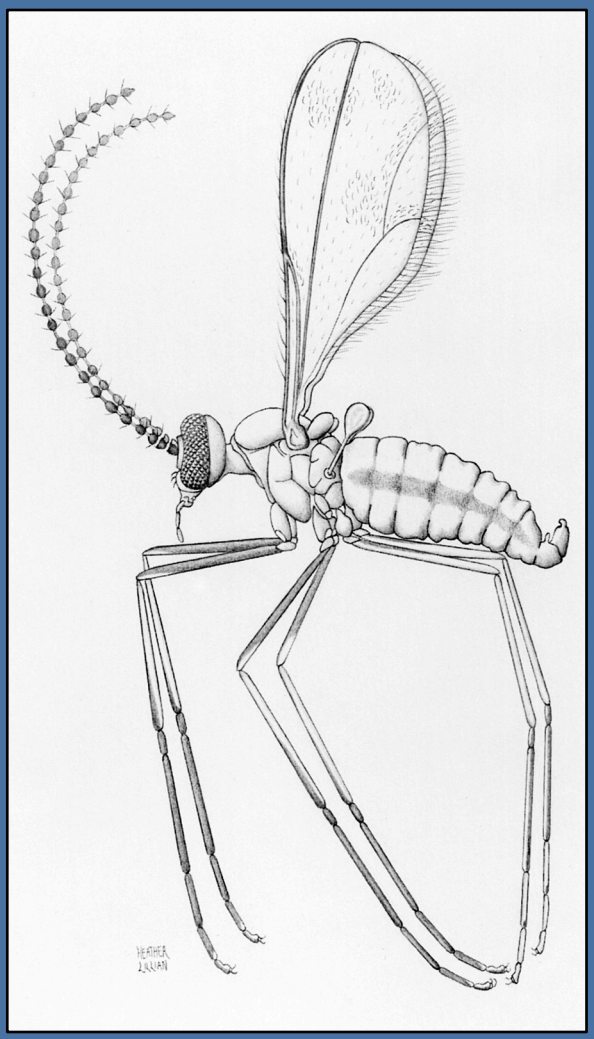
THE PLANT-FEEDING GALL MIDGES OF NORTH AMERICA

Second Edition – 2026



Raymond J. Gagné

Resident Affiliate, Department of Entomology, National Museum of Natural History, Smithsonian Institution.

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The author was born in 1935 in Meriden, Connecticut. He graduated from Meriden High School in 1953. Following service in the U.S. Army, he attended the University of Connecticut where he chose zoology and entomology from among many other appealing majors. After receiving his BA in1961 he earned an MS in 1963 at Iowa State University at Ames with a thesis on a genus of fungus gnats. He then attended the University of Minnesota in St. Paul where he turned to the study of gall midges and plants and was granted the PhD in 1967. From 1965 until retirement in 1996, he was employed as a research entomologist in the Systematic Entomology Laboratory, Agricultural Research Service, USDA, in Washington, DC. He retained his office at the Museum of Natural History as a USDA Collaborator and Smithsonian Research Associate until 2025, when he elected to work from home in Silver Spring, Maryland, where he lives happily ever after with his wife Sally.

The cover drawing of *Contarinia maculipennis* Felt was executed by Heather Lillian for Gagné (1995b). The insect is an Asian polyphagous pest of agricultural commodities, originally reported from Hawaii. It has been intercepted in North America but is not yet known to be established here.

This book is dedicated to the collectors
who alerted me to their new discoveries.

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There are more things in heaven and earth, Horatio,
Than are dreamt of in your philosophy.

Hamlet I, v. 166
William Shakespeare

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Metz, Systematic Entomology Laboratory, Agricultural Research Service, Washington, DC; **†Charles D. Michener**, University of Kansas, Lawrence; **Douglass R. Miller**, Systematic Entomology Laboratory, Agriculture Research Service, USDA, Beltsville, Maryland; **Jeffrey C. Miller**, Oregon State University, Corvallis; **Meredith Miller**, Centre for Biodiversity Genomics, University of Guelph, Ontario; **Brit Minor**, Charlottesville, Virginia; **Joseph Moisan-de Serres**, Laboratoire d'Expertise et de Diagnostique en Phytoprotection, Québec; **Lily Morello**, Waltham, Masachusetts; **Colin R. Morrison**, Department of Integrative Biology, University of Texas, Austin; **†John C. Moser**, U.S. Forest Service, Pineville, Louisiana; **Jason L. Mottern**, USDA APHIS-PPQ-PHP, National Identification Services, Smithsonian Institution, Washington, DC; **Ivan Munkres**, William and Mary University, Williamsburg, Virginia; **Louis Nastasi**, Pennsylvania State University, University Park; **John W. Neal, Jr.,** Agricultural Research Service, Beltsville, Maryland; **Nolan H. Newton**, Raleigh, North Carolina; **†W.C. Nijveldt**, Wageningen, The Netherlands; **Kenji Nishida**, University of Costa Rica, San Jose; **Allen L. Norrbom**, Systematic Entomology Laboratory, Agriculture Research Service, USDA, Washington, DC; **Ronald A. Ochoa**, Systematic Entomology Laboratory, Agriculture Research Service, USDA, Washington, DC; **Brent S. Olson**, Loess Hills State Park, Pisgah, Iowa; **Eben A. Osgood, Jr**., University of Maine, Orono; **Gary Ouellette**, Animal and Plant Health Inspection Service USDA, El Paso, Texas; **Kent Ozment**, National Research Conservation Service, USDA, Vincennes, Indiana; **Michael W. Palmer**, Blue River, Oregon; **William A. Palmer**, Brisbane, Queensland, Australia; **Diane Paré**, Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec; **Janice Pareira**, Smithsonian Environmental Research Center, Edgewater, Maryland; **Jerry Payne**, Lizella, Georgia; **Alex de la Paz**, Bristol, Florida; **John Pearson**, Iowa Department of Natural Resources, Des Moines; **Elaina N. Pecher**, Chesapeake and Ohio Canal National Historical Park, Williamsport, Maryland; **Robert W. Pemberton**, Agricultural Research Service, Albany, California; **Jorge E. Peña**, Department of Entomology and Nematology, University of Florida, Gainesville; **Juan Manuel Perilla Lopez**, Wright State University, Dayton, Ohio; **D.P. Peschken**, Agriculure Canada Research Station, Regina, Saskatchewan; **Jessica Petersen**, Minnesota Department of Natural Resources, Saint Paul, Minnesota; **Zachary Phillips**, Santa Barbara Botanic Garden, Santa Barbara, California; **Michael J. Plagens**, Glendale, Arizona; **John D. Plakidas**, Pittsburgh, Pennsylvania; **George O. Poinar**, Department of Entomology, Oregon State University, Corvallis; **Paul D. Pratt**, Invasive Plant Research Laboratory, ARS, USDA, Fort Lauderdale, Florida; **Matthew F. Purcell**, Australian Biological Control Laboratory, ARS, USDA, Indooroopilly, Queensland; **Brian G. Rector**, Biological Control of Weeds, Agricultural Research Service, USDA, Albany, California; **Lynne Rieske**, University of Kentucky, Lexington; **Edward G. Riley**, Texas A&M University, College Station; **Thomas O. Robbins**, Temple, Texas; **William H. Robinson**, Virginia Polytechnic Institute and State University, Blacksburg; **Emily A. Rock**, Wayne General and Technical College, Orrville, Ohio; **Erick J. Rodriguez**, Florida State Collection of Arthropods, Gainesville, Florida; **Lucretia Rodriguez**, Systematic Entomology Laboratory, Agriculture Research Service, USDA, Washington, DC; **†Charlie E. Rogers**, Agricultural Research Service, Tifton, Georgia; **†Odette Rohfritsch**, Institut de Botanique, Strasbourg, France; **Deborah L. Roney**, Vienna, Virginia; **Hans Roskam**, Rijks Universiteit, Leiden, The Netherlands; **Tomas Roslin**, University of Helsinki, Finland; **Michèle Roy**, Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec; **Ronald A. Russo**, Bellingham, Washington; **†Curtis W. Sabrosky**, Systematic Entomology Laboratory, Agricultural Research Service, Washington, D.C.; **Shinsuke Sato**, Plant Protection Laboratory, Ibaraki Agricultural Center, Ibaraki, Japan; **Joseph C. Schaffner**, Texas A&M University, College Station; **Sonja**

Scheffer, Systematic Entomology Laboratory, Agriculture Research Service, USDA, Beltsville, Maryland; **Nathan Schiff**, Southern Hardwoods Laboratory, USDA Forest Service, Stoneville, Mississippi; **Timothy D. Schowalter**, Oregon State University, Corvallis; **Thomas Shanower,** Kansas State University, Manhattan; **Bill Sheehan**, Athens, GA; **John T. Schulz**, North Dakota State University, Fargo; **Alyssa Seemann**, Systematic Entomology Laboratory, Agricultural Research Service, Washington, D.C.; **Joseph D. Shorthouse**, Laurentian University, Sudbury, Ontario; **Bradley J. Sinclair**, Canadian National Collection of Insects and Ottawa Plant Laboratory, Ottawa, Ontario; **Marcela Skuhravá**, Prague, Czech Republic; **Adrian Smith**, Department of Biological Sciences, North Carolina State University, Raleigh; **Cecil Smith**, Pennsylvania State University, University Park; †**David R. Smith**, Systematic Entomology Laboratory, Agricultural Research Service, Washington, D.C.; †**Floyd F. Smith,** Agricultural Research Service, Beltsville, Maryland; **Mario Solinas**, University of Perugia, Perugia, Italy; **Ed Stansbury,** Lacey, Washington; **Gary J. Steck**, Florida State Collection of Arthropods, Gainesville, Florida; **James R. Steffan**, Chicago Botanic Garden, Glencoe, Illinois; †**Carl E. Stegmaier**, Tallahassee, Florida; **Warren Steiner**, Wittman, Maryland; †**George C. Steyskal,** Systematic Entomology Laboratory, Agricultural Research Service, Washington, D.C.; **Peter Stiling**, University of South Florida, Tampa Bay, Florida; †**Manya B, Stoetzel**, Systematic Entomology Laboratory, Agriculture Research Service, USDA; **Donald R. Strong**, Bodega Marine Laboratory, Bodega Bay, California; **Ramsey Sullivan**, Alaska Botanical Garden, Fairbanks; **Jil Swearingen**, Wittman, Maryland; †**Edvard Sylvén**, Swedish Museum of Natural History, Stockholm; **Elijah Talamas**, Florida State Collection of Arthropods, Gainesville, Florida; **Nathan Taylor**, Sul Ross State University, Alpine, Texas; **Robert A. Thomas**, Center for Environmental Communication and Environmental Program, Tulane University, New Orleans, Louisiana; †**Jimmie Thompson**, Ames, Iowa; **Makoto Tokuda**, Laboratory of Systems Ecology, Saga University, Saga, Japan; **James Trager**, Gray Summit, Missouri; **Gene-Sheng Tung**, Taiwan Forestry Research Institute, Taipei; **Serina Turangeau**, Royal Botanical Gardens, Hamilton, Ontario; **Nami Uechi**, Institute of Fruit Tree and Tea Science, National Agriculture and Food Research Organization, Tsukuba, Ibaraki, Japan; **Andrew Ulsamer**, Systematic Entomology Laboratory, Agriculture Research Service, USDA, Washington, DC; **Karl R. Valley**, Harrisburg, Pennsylvania; **John van der Linden**, Iowa; **David L. Wagner**, Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs; **James K. Wangberg**, University of Wyoming, Laramie; **Jeff Ward**, Brice Creek, Oregon; **Gwen L. Waring**, Arizona State University, Flagstaff; **Michele R. Warmund**, Division of Plant Sciences, University of Missouri, Columbia; **Alexandria Wenninger**, University of Alaska, Fairbanks; **Alfred G. Wheeler, Jr**., Clemson University, South Carolina; **Gregory Wheeler**, Agricultural Research Service, USDA, Fort Lauderdale, Florida; **Gabriel Whitlock,** Asheville, North Carolina; **Robert C. Wilkinson, Jr**., University of Florida, Gainesville; **Andrew H. Williams**, Department of Entomology, University of Wisconsin, Madison; **Michael J.** and **Windsong Cornelius Wise**, Roanoke College, Roanoke, Virginia; **Sarah M. Witiak**, Virginia State University, Petersburg, Virginia; **Norman E. Woodley**, Systematic Entomology Laboratory, Agriculture Research Service, USDA, Washington, DC; **Peter Woods**, Western Pennsylvania Conservancy, Pittsburgh; **William M. Woods**, Western Australian Department of Agriculture, South Perth; **James Woolley**, Department of Entomology, Texas A&M University, College Station; **Karen Wright**, Department of Entomology, Texas A&M University, College Station; **Luann Wright**, San Diego, California; **Susan A. Wright**, Invasive Plant Research Laboratory, ARS, USDA, Gainesville, Florida; **Allen L. Wuensche**, Wilson, Texas; **Harry O. Yates III**, U.S. Forest Service, Athens, Georgia; **Allen M. Young**, Milwaukee Public

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Preface to the Second Edition

This revision of *The Plant-Feeding Gall Midges of North America*, originally published in 1989, began as soon as the earlier book was in press. Since then, more than half again as many records of plant and gall midge associations have come to light. Much new general knowledge, from revisions to unpublished observations about these insects, has accrued and is summarized here.

The pencil illustrations for the earlier edition, all drawn by Debi Roney, are reused. Plates of drawings made by Ms Roney, Susan Grupp, Linda Heath Lawrence and Heather Lillian for subsequent publications on gall midges are also reused. Color plates, some reused, some new, were prepared and edited by Michael Althaus, J. Marie Metz, Lucrecia Rodriguez and Alyssa Seemann. Color photos, expensive to publish in 1989, are used much more liberally here. I am grateful to Cornell University Press for ceding the copyright of the earlier book to me.

The geographic range of this edition is broadened to include Mexico. Also recorded here are some species from the West Indies and Central America that are not yet known in North America but may eventually occur here. These include pests of pepper, mango, and avocado. Beneficial species that may eventually be introduced purposely for control of established non-native plants, such as tamarisk and cheatgrass, are also mentioned.

Scientific names of plants and their family placement accord with *Plants of the World Online* produced by the Royal Botanical Gardens at Kew. Consequently, several family and generic names have been changed from the earlier edition. Common names of plants in the keys are given only for genera, and then only those in general use. Authors of scientific names of plants are unnecessary here and are not provided.

1 Introduction

This book is a guide to the plant-associated gall midges of North America with keys to their galls and other plant damage. Recorded here are 1,370 species of gall midges known from 1,265 plant galls and other manifestations. The earlier edition (Gagné 1989) reported 891 cecidomyiids on 732 manifestations known at that time. Of the gall midges treated here, 450 or 40% of them are identified only to genus or family level. Most of the unidentified species are probably new to science and provide a measure of the amount of work still to be done on the family. Although careful and judicious descriptions of the undescribed taxa are lacking, the present generic identifications still offer information on general appearance and habits.

Available information on galls, biology, hosts, and distribution is given for each species listed in the keys of Chapter 8. Known distribution for individual species is painted with a broad brush. Geographical ranges are given as provinces of Canada and states of the United States and Mexico, unless broader distributions such as "eastern North America" are warranted. General information for each genus mentioned is summarized in Chapter 3. Although the book is intended for a general audience, some knowledge of biology and basic entomology is assumed of the user. This book keeps technical terms to a minimum. A glossary of technical terms is provided.

An Overview of the Gall Midges

Cecidomyiidae, numerous, ubiquitous, and economically important, comprise one of the largest families of flies. More than 6,885 species have been described, but their actual number is inestimable (Gagné & Jachhhof 2025). This is clear from the large number of unidentified species in the present keys to plant damage, the many additional undescribed species represented in museums, and the great diversity commonly collected in insect flight traps. Gall midges are perceived as a difficult group, due mainly to their small size. The need to mount specimens on slides for proper examination adds to the investment of time required for their proper study and is a major reason for their neglect.

Gall midges or Cecidomyiidae are part of the superfamily Sciaroidea, which is a very old assemblage present in the Triassic Period and whose larval stage is mainly associated with fungi (Wiegmann & Yeates 2017). Larvae of Cecidomyiidae differ mainly from other Sciaroidea by their minute heads with piercing-sucking instead of chewing mouthparts and by the presence of a spatula, a hard, dermal structure on the venter of the thorax of the third instar (Plate 1) (Gagné 2024).

The family is divided into six subfamilies. The larvae of five of them, the basal groups, still ply the ancestral niche as fungivores in decaying organic matter and mushrooms. They are not treated further here, but their numbers and outlines are summarized in Appendix 1 of Gagné & Jaschhof (2025). Their remarkable diversity is treated in great depth in two books by Jaschhof & Jaschhof (2009, 2013). The remaining and largest subfamily, the Cecidomyiinae, comprises the part of the family associated with living plant tissue. The subfamily includes also various

fungivores, as well as predators that feed on other arthropods. It should be noted that the common name, gall midges, only partially characterizes the family.

With few exceptions, only Cecidomyiinae associated with plants in North America are treated here. These include predaceous gall midges that feed upon gall midges and various other phytophagous insects and mites. Supertribal and tribal subdivisions of Cecidomyiinae are summarized in Gagné & Jaschhof (2025). A key to adults of North American genera of the subfamily can be found in Gagné (2018a).

Cecidomyiinae are best studied with proper attention given to larvae, pupae and adults of both sexes. All or most feeding is done by the larvae, which imbibe liquids predigested by salivary secretions. Larvae are legless and shaped for various active or sedentary modes of life. This stage may last from two weeks to two or more years, with some of that time spent in aestivation or hibernation. Most adults are fragile and tiny, with a body length usually less than 3 mm. They are generally short lived, feed little if at all, and then only on free liquids. Adults of some non-gall making groups have been implicated in pollination (Young 1985, Feil 1992, Gagné et al. 1997, Gardner et al. 2019, Kawakita et al. 2022).

Early History of North American Gall Midge Study

The first cecidomyiid described from North America was *Mayetiola destructor* (Say 1817), a European pest of wheat first noticed here in 1778 in Long Island, New York, from where it quickly spread to all wheat-growing regions of the country (Fitch 1846). The common name Hessian fly fixes the source of this pest to the disembarkation during the Revolutionary War of mercenary Hessian soldiers with infested wheat straw used as bedding and horse fodder. By 1900, fewer than 150 North American gall midges had been described from this continent, nearly all of them associated with particular galls or plant damage. Noteworthy early work was done by Fitch (1845, 1859, 1861), Osten Sacken (1862, 1863, 1869, 1870, 1871) and Walsh (1864), each providing good written descriptions for their time, some accompanied by illustrations.

The generic classification used then was rudimentary, so most European and American species were placed in the genus *Cecidomyia*, then a convenient catchall category. At least in North America one could still identify most known species by their hosts and galls. Until 1907, those were as important for recognition of a species as were the anatomical characters of the gall midges themselves. Descriptions of adults and even of larvae were made, but few species in North America had yet been described from adults caught in flight. In a fine example of early work, Beutenmüller (1907a), described and provided illustrations of galls and larvae of 20 new species from eastern United States, each associated with a particular gall on a known host.

In the same year, a paper by Felt (1907a) forced a change in cecidomyiid taxonomy in North America. In that paper Felt described perfunctorily and without illustrations 179 species of gall midges, only 15 of them reared from known hosts. The remainder had been caught in flight or resting on plants. Beutenmüller (1907b) criticized Felt for describing species with no definite host associations and basing the names of 96 species on plants from which the species were swept or in whose vicinity they were found. Felt (1907c) responded that the published descriptions were preliminary and based on more detailed knowledge than appeared in the descriptions. He added in his defense that other groups were studied based only on adults, so one could reasonably expect that a natural classification based on adults would encompass and anticipate all other information about the group. Felt did not respond to Beutenmüller's criticism about naming species for plants

on or near which the flies were caught, but that practice coined names such as *liriodendri* (“of yellow poplar”) and *aceris* (“of maple") for species that belong to genera now known to be restricted to grasses and oaks, respectively.

Felt was correct that the study of cecidomyiids could not forever be held hostage to their hosts, but he did not foresee that some of his species could never be identified subsequently. An example of the difficulty is the genus *Calamomyia* that includes 11 Felt species, each known from a single specimen caught in flight. *Calamomyia* larvae live in culms of grasses. Males caught in flight can readily be placed to genus but females only tentatively so. Accurate identification of a *Calamomyia* requires both sexes as well as the larva, in which case the host species will also be known (Gagné 1969b). No benefit accrues to having those 11 available Felt names, which may never be assigned with certainty to any reared species.

In time Felt developed his preliminary descriptions slightly more fully in a series of works on American gall midges (Felt 1913, 1915a, 1915b, 1916a, 1918a, 1918c and 1921). In those and a continuous stream of separate, short taxonomic papers between 1907 and 1939, he described additional new species from all over the world. Felt described 965 species from North America alone. Many of them have since been found to be synonyms. Eleven species of Lestremiinae were each described under four or more names. *Neolasioptera vitinea* (Felt), from a stem gall on grape, was described as new three times, each in a different genus. Remington (1958) aptly assessed Felt’s work on gall midges: “… almost all of [Felt’s] intensive study of the North American gall midges was crowded into the fifteen-year period beginning around 1905. During this time he proposed as new a very large number of species, but other duties and interests subsequently drew him away from the thorough digestion and revision of his work which one might have wished would follow.” Those other duties and interests as well as his taxonomic work are summarized in two fine obituaries by Bromley (1944) and Muesebeck & Collins (1944).

The system Felt (1925) used for classification of the family was largely developed by a French contemporary, J.-J. Kieffer. That scheme (Kieffer 1913) was still the one in general use when I began my work on the group in 1963, but its general outline has since become somewhat modified, as reflected in Appendix 1 of Gagné & Jaschhof (2025).

Taxonomy

Genera are subjective categories. One should not look upon any two or more as representing similar or objective criteria. They are not equivalent in age, particularly if one compares a genus of Lestremiinae with one of the much younger Cecidomyiinae. Genera should be monophyletic, a condition often difficult to determine for gall midges, in which similar adaptive strategies have developed separately. Larval niches, for example, correlate well with changes in body form and losses of various structures regardless of blood ties (Sylvén 1975). Some of the most distinctive and taxonomically helpful anatomical characters used in identification keys, such as the number of antennal flagellomeres and palpal segments, shape of tarsal claws and presence of elongate ovipositors, have apparently come about separately many times.

The truly monophyletic genera are mostly made up of species that fill a certain niche on a natural group of plants. *Caryomyia*, with its 56 species forming complex leaf galls on hickories (*Carya*: Juglandacee), certainly belongs in the tribe Cecidomyiini, but its closest relative is not apparent (Gagné 2008). Relationships even among species of *Caryomyia* are unclear. During successive glacial periods when the geographic range of hickories was severely restricted to

isolated pockets in southeastern North America, many species of *Caryomyia* must certainly have become extinct. After having been isolated subsequently in the various ice age refugia, those species that remained from the previous interglacial period and any new species that developed in the interim, migrated north with their hosts during the new interglacial. The presumed result, through several successive glaciations, is that extant species differ in age and provenance.

Taxonomic matters peculiar to gall midge names are worth mentioning here. At one time species were named from their galls alone. For example, Osten Sacken (1875) described a leaf gall on nettle as *Cecidomyia urnicola* (now in *Dasineura*). According to present rules of nomenclature (ICZN 1999), the name, if proposed before 1931, is available because it is based on the work of an animal. Even before 1931, though, not everyone agreed that this practice was proper. Some specialists did not agree that a name based on the larval stage alone was available because it was not the adult or "perfect form." (Löw 1878; see Gagné 1972). Löw (1878) renamed species that had been based on galls or galls and larvae, but the earlier name must now be used.

Some specific names were coined as two separate words following the generic name, e.g., *Cecidomyia salicis batatas* Walsh (1864) for the gall midge that forms the potato-like (*batatas*) stem gall on willow (*salicis*). That name is not available because a specific name must be a single word and refer to a single entity (ICZN 1999). When Osten Sacken (1878) subsequently listed *salicisbatatas* in a catalog as one word, he automatically became the author because he was first to use the name in that form with reference to the earlier description. The name proposed as *Cecidomyia pini inopis* Osten Sacken (1862) might appear to be a similar instance, but the last two words refer to a single entity, i.e., the plant *Pinus inopis* (= *Pinus virginiana*). The double specific name is simply closed-up as *piniinopis* and considered valid with the original author and date (Gagné 1988). *Cecidomyia bigeloviae-strobiloides* Townsend (1893) was available because the words were united by a hyphen. Present rules require that the word be spelled without a hyphen, so the name is corrected to *bigeloviaestrobiloides* and considered available from the original description.

2 Anatomy

This chapter presents an outline of cecidomyiid external anatomy. Adult terminology follows the system generally applicable to all Diptera as standardized in McAlpine et al. (1981). Larval and pupal terminology for Cecidomyiidae was standardized by Möhn (1955, 1961b), after which only a few slight changes were made.

Egg

Eggs are smooth and ovoid to elongate-ovoid. In species characterized by long, attenuate ovipositors, one end of the egg is drawn out to a point (Kieffer 1901a, Wilson 1966, Isidoro & Lucchi 1989). Eggs may be white, yellow, orange, or red. The color may be permanent or change as the developing embryo matures (Roskam 1977).

Larva (Plates 1-17)

Cecidomyiid larvae are legless, elongate-ovate and usually dorsoventrally flattened. Full-grown examples from various genera are illustrated in Plates 1-4. Larvae may be white, yellow, orange, or red depending on species or age, and the color may vary within a species. In Japan, a widespread Japanese species is yellow throughout the country but also white in southern Japan (Sunose 1979).

Larvae have three instars. Some of the pedogenetic species, all fungivores, are exceptions with only one or two instars (Wyatt 1967), but they do not feed on plants and are not considered further here. Instars may be differentiated from one another by head capsule measurements, anatomical differences and observations over the course of their life cycle (Parnell 1964, Roskam 1977, Gagné & Hatchett 1989, Peña et al. 1989, Gagné & Doane 1999). Reports exist of four instars: in some of those cases, the pre-diapausing third instar was counted as a fourth (e.g. Metcalfe 1933). As the pupa begins to develop in the late third instar, the larva changes shape slightly. This has sometimes been called a prepupal stage, but no molt occurs until the pupa breaks through the larval skin. In other cases, a developing early third instar still inside the second and showing a partial spatula was considered an additional instar (Abbas 1965, Haridass 1987). One claim for four instars (Borkent 1989) was based on samples that contained larvae of three separate species (Gagné & Doane 1999).

The largest growth increment for most species is usually the third instar. One exception is the Hessian fly in which the third instar does not feed at all. It develops fully inside the second-instar skin, termed a larvarium (Plate 19 (4), which by then is hard and brittle, analogous to the separately derived puparium of higher Diptera (Gagné & Hatchett 1989). The pupa then develops, pushes through the hard second instar skin and upwards to escape the confines of the wheat stem. In *Sitodiplosis mosellana* (Géhin), the third instar remains inside the second instar skin, and aestivates without feeding before it exits, drops to the soil and forms a cocoon (Gagné & Doane 1999).

The larval head capsule is extremely reduced in size compared to other Sciaroidea (Gagné 2024). It is conical and eyeless but has sensory plates, papillae, and short, cylindrical antennae (Solinas 1965a-c, Solinas et al. 1987). The head capsule is modified for various modes of life. Predators and first instars of most larvae have long antennae, more than three times as long as wide, but antennae of second and third instars of most gall midges are only about twice as long as wide. Movable mouthparts are composed of a pair of vertically articulated mandibles and a pair of maxillary plates (Solinas 1971). To feed, the anterior part of the head capsule is closely appressed to the host tissue, the mandibles pierce, abrade or grasp the host, salivary secretions are expressed, and strong pharyngeal dilator muscles effect ingestion through the esophagus (Solinas 1968, 1971).

Posterior to the head are the neck or collar segment, three thoracic segments, and nine abdominal segments, including the terminal or caudal segment (Plate 1). First instars are metapneustic, i.e., with a pair of spiracles on only the eighth abdominal segment. Second- and third-instar larvae are peripneustic, with spiracles on the first thoracic and first through eighth abdominal segments. The anus is on the ninth or terminal segment. It is usually located ventrally in plant-feeding gall midges, except caudodorsally in many Asphondyliina. The anus is caudal in some primitively mycophagous groups (some Lestremiinae, Micromyinae and Winnertziinae (Mamaev & Krivosheina 1965)) and dorsal in many predators (*Lestodiplosis* and related genera).

The integument is smooth, spiny, or rough. Raised, horizontal, roughened ridges or traction pads used in locomotion occur ventrally, mainly on the abdominal segments, even on larvae that are otherwise smooth. The body has regularly situated sensory organs called papillae that are important in taxonomy for their number, placement and setation. The basic papillar pattern of a cecidomyiine third instar is shown in Plate 1. Some papillae have become lost on some of the more sedentary species, particularly those that pupate inside complex galls. Some larvae have ventral pseudopods or dorsal, lateral or terminal lobes.

The third instar usually has a spatula, which is a hard, pigmented, usually anteriorly emarginate dermal structure on the venter of the prothorax. The spatula is a uniquely cecidomyiid structure whose presumed original use was for digging through the soil by full-grown larvae prior to pupation. This is its actual use in many plant-feeding cecidomyiines (Pitcher 1957, Milne 1961). The spatula is also used by some larvae in cutting their way out of woody stem galls. Such larvae usually have robust spatulas (Plate 8 (6-7, 9)). The spatula is secondarily lost in some genera in which the function of exiting the gall is taken over by the pupal stage (Jones et al. 1983, Dorchin et al. 2009). An oddity that occurs independently in several unrelated genera is the appearance of a spatula in the second instar as well as in the third (Gagné 2008, Gagné & Moser 2013).

Third instar larvae of many Cecidomyiidi that pupate in the soil jump considerable distances before burrowing. This habit presumably functions to spread out a population on the ground. It was once believed that the spatula was involved in jumping by somehow connecting with the terminal segment, an error I repeated (Gagné 1989). More recently, Farley et al. (2019, 2022) determined that the mechanism involved is the juxtaposition of ventral spicules on the third and last segments of the body before the body launches into the air. See Farley et al. (2019) for a link to a video of the action.

Most larvae form cocoons in which pupae will ultimately develop. These are made of silk derived from salivary glands after the function of the glands changes with age. Many gall makers that pupate inside galls do not make cocoons. In some genera, the penultimate instar becomes hardened to form a protective coating within which the third instar develops (Gagné & Hatchett 1989, Gagné & Doane 1999, Solinas 1986).

Pupa (Plates 18-19)

The pupal stage offers diagnostic features for taxonomy. Pupae of groups that cut or force an exit from the confines of plant galls may have the antennal bases developed into a pair of hard, variously pointed or serrated projections. This stage may additionally bear pointed prominences on the face and enlarged, rows of spinelike abdominal microtrichia. Pupal terminology for this stage was standardized by Möhn (1961b) in his comprehensive study of the tribe Asphondyliini.

Adult (Plates 20-22)

Adults are fragile flies with reduced wing venation. The head is composed mainly of the eyes that nearly or fully join at the top of the head. Some reduction in eye size and number of facets occurs in certain groups, particularly the Oligotrophini, in which the lateral eye facets are usually farther apart than elsewhere. Eyes of some predaceous groups are fully separated laterally, resulting in one dorsal and two lateral eyes. Antennae are unique among Diptera for their circumfila, produced by nerve cells that bifurcate and join end to end with their neighbors to produce characteristic threadlike structures girdling the flagellomeres (Slifer & Sekhon 1971). These and other antennal sensory structures were illustrated in fine detail in Solinas & Nuzzaci (1987) and Solinas et al. (1987). Male antennae are usually longer than female antennae, and flagellomeres of most males in the supertribe Cecidomyiidi each consist of two separate nodes. Mouthparts include the maxillary palpi and, forming a tube for the ingestion of liquids, the dorsal labrum, the lateral labella, and the ventral hypoproct. A few groups have elongated mouthparts, sometimes associated with a modified head, long neck, or other body modifications, presumably adapted for specialized feeding (Dorchin et al. 2015, Gagné & Boldt 1989, Gagné & Huerta 2023). In certain groups, the mouthparts are greatly reduced and probably nonfunctional (Jones et al. 1983). Palpi have primitively four-segments that in some genera become reduced to as few as one, usually in conjunction with general reduction of the remaining mouthparts.

The wing of Cecidomyiinae is reduced to five major veins. The costa (C) is unique in Diptera for encircling the wing, usually with a slight break at its juncture with R_5. Vein R_5 is usually as long as the wing, but foreshortened in many Lasiopteridi, and greatly reduced to nearly half the length of the wing in the Lasiopterini and Alycaulini. Some sexual dimorphism occurs in leg length, as in some male *Rhopalomyia* spp. that have longer legs than females (Plate 22). The shape of the tarsal claws is important in taxonomy. The empodium, a pad-like appendage between the tarsal claws may be as as long as the claws or much shorter. In some species and genera, including most of those that live on conifers, even from diverse lineages, the empodium is somewhat longer than the claws. Pulvilli, padlike appendages near the lateral side of each claw, are usually about a third as long as the claws but may be greatly reduced or fully as long as the claws.

The female abdomen of plant-feeding gall midges has evidently undergone elongation many times, making it suitable for placing eggs in crevices between bud scales or flower parts or even piercing plant tissue. The progression from a short to long ovipositor can be seen even in several monophyletic species groups and genera (Roskam 1977, Gagné & Moser 2013). Its cerci are fused into one lobe in most Lasiopteridi, a modification that has occurred separately also in a few Cecidomyiidi. Ovipositors modified for piercing plant tissue may be shaped like a needle

(*Asphondylia*), a saw (*Lygocecis*), a blade (*Procystiphora*), or a hook (*Cystiphora*, *Monarthropalpus*) (Gagné 2018a).

The male terminalia comprise the ninth and tenth abdominal segments. The terminalia are diverse and bear the most useful characters in gall midge taxonomy. Their variety and use in identification can be appreciated in the key to cecidomyiine genera of Gagné (2018a).

3 Biology

This chapter reviews some of the many ways by which Cecidomyiinae have adapted to cope with different hosts and environments.

Immature Stages

Searching and Settling

Larvae hatch within a few days of egg deposition. Those that hatch from eggs laid upon a plant surface must crawl to an appropriate feeding site. Many die from misdirection or desiccation during this period. Days after some larvae of *Primavera porrecta* (Felt) have become properly enveloped in fast-growing elm samaras, others can still be seen crawling over the other flower parts, searching for a suitable feeding site (Gagné 2002). Larvae of other groups that hatch from eggs deposited within host tissue can of course feed on host tissue directly. Larvae in simple galls such as leaf rolls are often gregarious; those in complex galls tend to be single or, if more than one, separated in individual chambers.

Once settled on the proper host tissue, larvae begin to affect host tissue through their salivary secretions (Stuart & Hatchett 1987). Galls can be seen to develop quickly and encompass the larvae, even before larvae show measurable growth. Once the gall has formed, larvae, except for those that temporarily enter diapause, begin to feed and soon molt into the second of their three instars. *Dasineura balsamicola* (Lintner), an inquiline often found in galls of *Paradiplosis tumifex* Gagné on balsam fir, lays its eggs near and at about the same time as the gall maker. The newly hatched larva of the inquiline searches for the gall-making larva that has already begun to settle. The inquiline then remains close to the gall maker while the plant tissue grows around both (Akar & Osgood 1987).

Stem-infesting species reportedly bore into tissue. Wilson & Heaton (1987) observed larvae of *Neolasioptera brevis* Gagné penetrate the soft tissue of new shoots of honey locust while gyrating their bodies from a position perpendicular to the stem. Within 8-10 hours, larvae made their way into the shoot, leaving traces of a channel behind them. The channel was subsequently detectable externally by a small, closed scar. Larvae eventually made use of the channels to cut an escape passage. This strategy has also been observed on stem galls of grape (Johnson 1952) and boneset, *Eupatorium* perfoliatum (pers. obs.).

Leaving the Host

Some larvae leave the host when full-grown; others first pupate in the gall and leave only as adults. Departing the host as larvae is probably the more primitive habit and is common to species that crawl freely among flower heads or live in simple galls such as leaf rolls that begin to decay after larval feeding ceases. With few exceptions, larvae that leave the gall to

pupate have a spatula (Plate 1), described earlier. This organ is unique to cecidomyiids and universally present in mature cecidomyiid larvae except in a few groups where it has been secondarily lost. The structure serves cecidomyiid larvae as the leading edge of the body during forward progress through the soil but has further adapted itself to cutting a passage through gall tissue (Gagné 2024).

Full-grown larvae of most groups spin cocoons in which to pupate. The silk comes from salivary glands and is spun from the mouthparts. A cocoon can be completed in 12-24 hours (Bishop 1954). Considerable variation occurs in cocoon making. In some cases, only part of a population makes a cocoon, at least in the laboratory (Bishop 1954). In nature this variation may be a response to the environment. For example, some full-grown larvae of *Resseliella dizygomyzae* (Barnes) on willow in Europe overwinter in their burrows in the host stem and do not spin a cocoon, while others drop to the ground and form a cocoon (Urban & Skuhravá 1982). Larvae of the spring generation of the European *Contarinia nasturtii* (Kieffer) and *Contarinia pisi* (Winnertz) may make ovoid cocoons just below the surface of the ground from which they emerge as adults 10-48 days later, or they may form spherical cocoons deeper down, in which they will diapause and overwinter (Coutin 1959). When dormancy in the spherical cocoons is broken, larvae exit the cocoon, move to the soil surface, reenter the soil, and make ovoid cocoons in which they pupate directly (Readshaw 1966). Some groups that pupate inside complex galls, including the genera *Rhopalomyia* and *Asphondylia*, do not make cocoons.

When the adult of *Dasyneura gentneri* Pritchard is fully developed inside the underground cocoon, the pupa forces its way through the narrow end. The pupa wriggles all the way to the soil surface before the adult breaks out (Bishop 1954). The adult emerges through a split behind the pupal prothorax and along the midline of its scutum, forming a T-shaped exit. The legs. once freed, push against the pupal skin to help pull the remainder of the body free. Once released from the exuviae, the legs and wings expand rapidly to their full size (Plate 26).

Individual adult emergence takes a few minutes to several hours, depending on humidity and temperature (Barnes 1930a). Emergence of most phytophagous species occurs at dawn or dusk, when conditions are usually more humid than at other times of day, but some species may emerge in the morning (Rock & Jackson 1985), at midday (Yukawa & Miyamoto 1979), late afternoon (Rock & Jackson 1985) or at night (Yukawa & Sunose 1976). Emergence of a population of primary plant feeders can last a week, but most individuals will emerge on the same day. Adults usually emerge over a period of hours, beginning in small numbers and peaking at some point. *Masakimyia pustulae* Yukawa & Sunose, however, has two separate peaks, one at dawn, the other at dusk (Sunose 1983b). Male emergence usually peaks slightly before female emergence (Teetes 1985, Yukawa et al. 1976, Yukawa & Sunose 1976, Rock & Jackson 1985, Rohfritsch 1997), which presumably allows for optimal sclerotization of the male genitalia before the females emerge.

The many unrelated groups that pupate in their galls instead of in the ground show two main strategies for leaving the host. In one, the full-grown larva uses its spatula to cut or enlarge a channel through which the pupa can later escape. In the other, the spatula may be partially or fully lost and the pupa performs the task of cutting a passage to the exterior.

Larvae of most Alycaulini and Lasiopterini live in woody stem galls. When full-grown, their larvae use the spatula to cut a cylindrical passage from their feeding tunnels almost to the exterior, leaving only a final thin layer of bark. Larvae of some species cut completely out to the exterior but then seal the opening with silk and retreat into the tunnel (Wilson & Heaton 1987). Larvae then pupate directly or enter diapause, depending on whether the adult will emerge in the present season or the following year. Eventual passage through the thin remaining bark or silk seal is made by the

first pupa to emerge. The pupa pushes through the weak covering and becomes lodged about two-thirds of the way through the opening, allowing a firm foundation for the fully developed adult inside to immediately begin its exit through the anterior end of the pupa. The first pupa to lodge in the exit passage is followed by the next individual that forces out the previous pupal skin, becomes lodged, and so on. Multiple pupae forcing their way together into the passage may occasionally cause a blockage that is fatal to the remaining individuals in the gall. These will emerge as adults inside the gall but have no way to escape (Frohne 1939; pers. obs.).

Larvae of other groups, such as *Rhopalomyia*, that pupate in their galls, have secondarily lost the spatula. The task of digging or forcing their way through sometimes woody gall tissue is done by the pupa, which has well-developed antennal bases and frontal horns suitable for the purpose (Plate 18). *Rhopalomyia* pupae from the hardest galls on sagebrush usually have the most conspicuous head armature (Jones et al. 1983, Russo 2021).

Most *Asphondylia* spp. have a robust spatula whose function is unknown. It may be used for plowing through the hyphae of its fungal symbiont to bring the larval mouthparts in juxtaposition to green tissue (Gagné 2024). Escape from their galls to the exterior is executed by the pupa once the adult has fully developed. To exit, the pupal body pushes forward along the exit passage by means of its abdominal spines while rotating along a longitudinal axis and cutting its way forward with its cephalic armature (pers. obs.).

A larva in a complex gall feeds with its head toward the core of the plant. When full-grown, the larva reverses its alignment within the tight space. In this way the pupa needs to move only anteriorly to exit the gall. Whether the larva or pupa cuts a channel, the mature pupa exits only about two-thirds of the way to the exterior, as with the stem gall midges. The tight passage then holds the pupa steady while the adult breaks out of the pupal exuviae (Plate 26).

Diapause

Cecidomyiid larvae have evolved many ways to survive dry or cold periods. These strategies synchronize adult emergence closely with the host cycle with the effect that the proper plant tissue is available at the time of oviposition.

In the temperate zone, diapause most commonly occurs in hibernating, full-grown larvae. In the first week of March in Beltsville, Maryland, adults of *Primavera porrecta* (Felt) emerge from the soil to mate and lay eggs on the then burgeoning buds of American elm. By mid-April, full-grown larvae drop to the ground and burrow into the soil, where they remain quiescent until the following February when pupation and adult emergence occur (Gagné 2002). Most *Neolasioptera* and *Lasioptera* species overwinter as full-grown larvae in their stem galls until spring when their hosts proffer the proper tissue. Larvae of *Neolasioptera rostrata* Gagné on *Baccharis* spp., remain in their flower pedicel galls until the following summer when their host comes into bloom (Gagné & Boldt 1989, 1995). Some *Asphondylia* and *Rhopalomyia* species overwinter as first-instar larvae in primordial plant tissue that will develop the following year. For instance, larvae of *Asphondylia ilicicola* Foote enter diapause as first instars almost from the time they hatch inside developing holly berries until late the following winter. The insect then progresses quickly though the remaining instars and pupal stage to emerge as adults just as the host again comes into flower (pers. obs.).

Most full-grown larvae of the large genus *Dasineura* drop to the soil where they remain unchanged until they pupate the following spring, but some exceptions occur. Adults of *Dasineura praecox* Gagné emerge from the ground in autumn to lay eggs among bracts in flower buds of their

host azalea, which blooms in late winter before the ground has thawed. Eggs hatch soon after deposition and overwinter as dormant first instars ready to begin feeding as soon as the flowers burgeon in early March (Gagné 1995c, 1996).

Diapause in the pupal stage is uncommon. The only North American record of pupal diapause is of *Contarinia negundinis* (Gillette) (Wilson 1966). Pupal diapause has been recorded elsewhere for *Resseliella lavandulae* (Barnes) in France (Coutin 1982) and *Hasegawaia sasacola* Monzen in Japan (Sunose 1978), although *H. sasacola* may overwinter either as a full-grown larva or as a pupa.

Onset of Diapause

Species with more than one generation per season needs to enter diapause only in the last of these generations. Nevertheless, part of each generation of some multivoltine cecidomyiids will enter and remain in diapause until the following spring (Coutin 1959, Johnson 1952, Vallotton 1969). The number of diapausing larvae increases with successive generations through the season (Readshaw 1966). The spring generation of adults of some species is thus a composite consisting not only of the last generation of the previous year, but also of some individuals from each of the previous year's other generations (Johnson 1952).

Diapause in hot climates may be brought on by drought. In sub-Saharan Africa, larvae of *Geromyia penniseti* Coutin & Harris are quiescent for 8-9 months in florets of millet. Pupation occurs when rain eventually falls (Coutin & Harris 1969). In addition to diapause, some species may undergo a short-term facultative diapause in response to drought. Larvae of *Contarinia nasturtii* (Kieffer) may become dormant during a drought, but growth resumes after a rainfall (Readshaw 1966, Vallotton 1969).

Extended Diapause

Diapause in full-grown larvae of some species can last several years. Most winter-diapausing larvae of species that drop to the ground will emerge the following year, but small numbers may not emerge for two or more years. Adults of *Sitodiplosis mosellana* (Géhin), the orange wheat blossom midge, emerged from soil for 13 successive years from one year’s brood of larvae, the number of emerging adults fewer in each succeeding year (Barnes 1956). *Lasioptera camelliae* Ohno & Yukawa on camellia in Japan exhibits extended diapause in its second-instar larva. The species usually has one full generation each season, but some individuals may take 2-3 years to complete their life cycle (Ohno & Yukawa 1984).

Extended diapause can benefit a species by insuring survival of some individuals through lean years or unusual weather. *Contarinia oregonensis* Foote in Douglas-fir cones may have an advantage in extended diapause because the cone crop is not always good each year (Hedlin 1964a). The Japanese *Hasagawaia sasacola* Monzen, another species with staggered emergence, is limited not only by the number of bamboo buds available, but also by competition with a lepidopteran for that same resource (Sunose 1978). Takasu & Yukawa (1984) show that prolonged diapause in the Japanese *Pseudasphondylia neolitseae* Yukawa may offer an advantage for escaping parasitism.

Adults

Life Cycles

Adult emergence is closely timed to a host's susceptibility. Most temperate zone gall midges emerge in spring. The elm samara gall midge, *Primavera porrecta* (Felt) emerges from the soil the first week of March in Maryland, mates and lays its eggs on the surface of burgeoning elm flower buds. By the time eggs are ready to hatch later in March, the buds have opened and floral ovaries are available for the larvae to form galls (Gagné 2002). *Dasineura praecox* Gagné on azalea, mentioned earlier in another context, is one exception to spring emergence from the soil. Adults emerge in autumn and oviposit in closed flower buds, a habit that effectively exploits its host, which may bloom before the ground thaws in late winter (Gagné 1995c, 1996). Emergence of adults that pupate inside the gall may depend more on temperature and moisture than on photoperiod, as it does for *Contarinia sorghicola* (Coquillett) on sorghum (Baxendale & Teetes 1983).

Most gall midges have either a one-year life cycle or a much shorter one, as in species that have successive generations in a single season. A few have a two-year life cycle, as observed in an undescribed *Dasineura* sp. found in red elm buds in Maryland. Its larvae live in bulblet-like galls that eventually grow into a leafy growth about 1 cm in length and diameter. First instars persist from spring of the first year, through winter and into early July of the next, when the outer green leaves of the buds turn brown and rough. Larvae then molt into the second instar in about mid-August and into the third instar toward the end of September. In spring of the third calendar year, larvae form a cocoon and pupate. Adults appear a short time later (pers. obs,). *Taxomyia taxi* (Inchbald) on yew in England has a one- or two-year life cycle, depending on whether larvae become embedded in active or dormant buds (Redfern 1975).

Flight

Males generally remain near the site where they emerge and where females appear simultaneously or soon after. *Primavera porrecta* females mate close to the ground, after which they immediately fly up to the tree limbs to lay their eggs on burgeoning flower buds (Gagné 2002). *Contarinia pseudotsugae* Condrashoff has a different habit. Its newly emerged adults follow the trunk of the tree to the crown. Males then swarm around the tips of branches and females rest on foliage until mated (Condrashoff 1962).

If males do not usually need to fly far from the emergence site, females may have to travel some distance to find the proper host. Gall midges are nonetheless relatively weak fliers. A grass-infesting gall midge in England was seen to fly above grasses in mild weather, but flew among them if it was windy (Jones 1940). Female *Rhopalomyia hirtipes* (Osten Sacken) are egg-heavy and fly clumsily until having deposited some of its eggs (Spence 1969).

True swarms, aggregates of males from which individuals leave to mate with females and later rejoin the swarm, have been reported for various cecidomyiids, phytophagous or not (Chiang 1968, Yukawa et al. 1976, Sunose 1983a, Baylac 1986, Yukawa & Kim 2021). Adults of plant-feeding gall midges may emerge simultaneously in such large numbers that any flying activity may appear to represent a swarm: an estimated 2000 individuals of *Contarinia pseudotsugae* emerged per square foot under Douglas-fir trees (Condrashoff 1962).

Courtship and Mating

Newly emerged females eject a pupal mecomium, the pupal waste products (Isidoro et al. 1992). They then extend and wave the ovipositor, making themselves attractive to males (Harris 1979, McKay & Hatchett 1984, Miller & Borden 1981, Yukawa & Miyamoto 1979, Baylac 1986). Virgin females of *Dasineura tetensi* (Rübsaamen) extruded their ovipositors when placed with males of the same species. Males reacted by vibrating their antennae and moving their wings before attempting to mate with the females. When males of *Dasineura plicatrix* (Loew) and females of *D. tetensi* were placed together, neither sex reacted; when males of both species were enclosed with virgin females of *D. tetensi*, the females extruded their ovipositors but only male *D. tetensi* reacted (Barnes 1939).

Some species apparently display no courtship prior to mating (Yukawa & Kim 2021). The male of *Mayetiola destructor* (Say) merely approaches the female from the rear, attaches, and mates in the side-to-side position (McKay & Hatchett 1984). This is true also for *Asphondylia morivorella* (Naito) in Japan. A male leaves its swarm and attaches immediately to a female (Sunose 1983a). Simple precopulatory activity involving wing vibration by males just before copulation has been observed in several plant-feeding gall midges (Barnes 1939, Yukawa & Miyamoto 1979, Isidoro et al. 1992), including an undescribed *Contarinia* sp. from sour gum (pers obs.). Isidoro et al. 1992) gave a detailed description of premating and mating behavior of *Dasineura brassicae* (Winnertz) and the functioning of its female sex pheromone glands.

The most complex courtship reported for Cecidomyiidae is that of a *Lestodiplosis*, a predator of a scale insect (Baylac 1986). As a male approaches a female from behind, she exserts the end of her abdomen. The male vibrates his wings at varying speeds and vibrates his antennae intermittently. Eventually the male pivots to face the opposite direction from the female and simultaneously grasps the end of her abdomen with his genitalia. Predaceous cecidomyiids may require more complex mating behavior than do plant-feeders to elicit a response from the female. They emerge intermittently over the length of a season and may be less numerous in a locality at any given time than a plant-feeder that emerges in great numbers almost simultaneously.

Most reports indicate that females mate only once. After mating, a female retracts the ovipositor, possibly cutting off pheromone release, and is evidently no longer attractive to males (Isidoro et al. 1992). The female then either flies off directly or rests on a leaf for a short while (Yukawa & Sunose 1976) or up to two hours (Readshaw 1966). The only known exception to females mating only once is *Rhopalomyia hirtipes* (Osten Sacken), of which some reportedly mated with several males (Spence 1969).

Males and females of any given species are usually present in approximately equal numbers, but individual females of many species give rise to progeny of all males or all females (Barnes 1931, Yukawa & Kim 2021). Daughter offspring of all-female families can produce all males, all females, or both males and females. The reason for this, at least in the Hessian fly, *Mayetiola destructor* (Say), is that paternally derived chromosomes are eliminated during spermatogenesis. The end effect is that females produce two kinds of gametes, female or male, but males produce only one kind (Gallun & Hatchett 1969).

Roosting

Many non-phytophagous Cecidomyiinae roost on spider webs at night, as do also Porricondylinae and Winnertziinae. All three subfamilies have a very short first tarsal segment whose connection with the second is easily broken (Plate 20). This presumably allows gall midges to escape readily when a leg is caught on a sticky substrate and may be an adaptation for passive roosting on spider webs. Cecidomyiids found on webs belong to either mycophagous or predaceous groups (per. obs.). These are relatively long-lived adults that may not emerge from the pupal stage synchronously. Some species roost at regular times (Kaufmann 1973, Sivinski & Stowe 1981, Young 1985). Adults of at least *Didactylomyia longimana* (Felt) are not merely passive inhabitants of the webs; they evidently share the spider's prey (Sivinski & Stowe 1981). *Aphidoletes aphidimyza,* a predator of aphids, reportedly mates exclusively on spider webs at night (Lenteren & Schettino 2003). In my own surveys of gall midges taken from spider webs, I have never found likely phytophagous species. Presumably, passive roosting is a habit apparently no longer needed by the shorter-lived plant-feeding groups.

Host Specificity

Most phytophagous gall midges are restricted to one host (monophagous) or to a few related hosts (oligophagous). The first condition is assumed for most phytophages when first described, the second may become apparent as more is learned. A few species are polyphagous and feed regularly on hosts that are not closely related. They live freely in flowers or cause simple bud swellings, not complex galls. Among polyphages taken from plants of several host families are *Prodiplosis longifila* Gagné and *Contarinia maculipennis* Felt (Gagné 1986b, 1995b, Uechi et al. 2012). Several species of *Asphondylia* are known to feed on separate hosts within a genus on a seasonal basis (Dorchin et al. 2015), but some are also known to live on separate plant families. In spring on Cyprus, *Asphondylia gennadii* (Marchal) attacks flowers of the carob tree, a legume. In summer when flowers on carob are no longer present, females lay eggs on several species of plants, including some Solanaceae and Brassicaceae (Gagné & Orphanides 1992). In Japan, *Asphondylia yushimai* Yukawa & Uechi feeds on soybean and other fabaceous hosts in summer-autumn but overwinters in fruit of *Prunus zippeliana* (Rosaceae) (Yukawa et al. 2003, Yukawa & Uechi 2021). Another Japanese species, *Asphondylia baca* Monzen lives in fruit of *Ampelopsis brevipedunculata* and *Cayratia japonica* (Vitaceae) in summer-autumn and on *Lonicera* spp. (Caprifoliaceae) in winter-spring (Uechi et al. 2004, Yukawa & Uechi 2021). *Asphondylia* with suspected alternate hosts include *Asphondylia uvarum* Gagné, a pest of grape known from Texas. Adults emerge from ripe fruit in June, but the oviposition site for the females of this generation is unknown. No further association of this pest on grape is apparent until it is found in the fruit again the following year (Gagné et al. 2018).

Many genera are restricted to a single host genus or tribe. The 56 species of *Caryomyia* are restricted to North American hickories (Gagné 2008). The 25 species of *Celticecis* are known only from hackberries, but this genus is more wide-ranging, found as it is in eastern North America and Asia (Gagné & Moser 2013, Gagné & Doğanlar 2013, Sato & Yukawa 2023). *Asteromyia* is a specialist on various genera of the asteraceous tribe Astereae. I only once found an exception to that rule when I noticed three black, circular blister galls reminiscent of *Asteromyia* carbonifera (Osten Sacken) galls on upper leaves of *Verbesina alternifolia* (Asteraceae: Heliantheae). The larvae inside were of an early instar, too young to identify but not unlike those of *Asteromyia*. Further searches

for such galls on *Verbesina*, where initially found and elsewhere, never yielded another example of black blister galls.

Some species show decided preferences for certain hosts, although they will sometimes lay eggs on related plants on which the larvae do not grow well (Åhman 1981, 1985, Morrill 1982, Pitcher 1955, Stokes 1953). *Dasineura brassicae* will lay more eggs on certain *Brassica* spp. than on others. Full-grown larvae from eggs laid on other than favored hosts weigh less at maturity and resulting females are less fecund than those on the preferred hosts (Åhman 1985, 1986). *Dasineura brassicae* may even lay eggs on plants where larvae will not develop (Åhman 1986). Females of the predaceous *Aphidoletes aphidimyza* (Rondani), a predator of aphids, were more attracted to brussels sprouts than to other plants if they were reared on that host (Mansour 1975).

Females are evidently attracted by host chemicals. *Dasineura brassicae* (Winnertz) females in Sweden fly passively with the wind until leeward of a host plant and then actively fly toward the host (Sylvén 1970, 1979). Females, but not males, of that species are attracted to sinigrin, a naturally occurring chemical in the brassicaceous host plant (Pettersson 1976). The Hessian fly selects varieties of wheat at least partially on physical characteristics, such as hairiness (Morrill 1982).

Oviposition

Females must manage to lay their eggs near the potential host's meristematic tissue. Having alighted on a plant, a female finds her way to the potential oviposition site by antennating and palpating the plant surface (Hallberg & Åhman 1987). When a suitable site is found, the female backs into it by feeling with the tip of her ovipositor (Hallberg & Åhman 1987, Marchal 1897). During oviposition on wheat the Hessian fly stands on the upper leaf surface of its host with its ovipositor oriented towards the base of the leaf. The eggs are thus oriented anterior end downwards. Upon hatching, larvae proceed downward until tightly ensconced between two leaves where they will settle and begin to feed (Morrill 1982).

Females of most plant-feeding gall midges have long, tapered, telescoped, usually pliable ovipositors. These allow the eggs to be inserted in narrow places such as between closed bud scales. The ovipositors of some groups, e.g., Asphondyliini, are stiff and insert eggs directly into plant tissue. The genus *Cystiphora* has a cultriform ovipositor with which it lays eggs directly into leaf stomata (DeClerck & Steeves 1988). When eggs are applied to the exterior of a plant, they are laid in characteristic patterns. They may be laid singly, in regular rows (Wilson & Heaton 1987), or in batches, either on the surface or in crevices of the host (Gagné 2002, Rosenheim et al. 2007).

Oviposition may depend on environmental factors. *Dasineura swainei* Felt lays eggs chiefly on the sunny side of open-grown spruces (Clark 1952). The European *Dasineura brassicae* (Winnertz), which lays its eggs in fruit, depends on feeding punctures made by the turnip seed weevil (Åhman 1986). As the density of the weevil increases, so does that of the gall midge (Sylvén & Svenson 1975). In North America the catalpa pod gall midge, *Contarinia catalpa*e (Comstock), also depends on weevil holes in the pods (pers. obs.). *Lasioptera berlesiana* Paoli, a Mediterranean species that lives in olives, inserts its eggs in oviposition punctures made by tephritid flies (Solinas 1967).

Mortality

Adults of plant-feeding cecidomyiids are short-lived. Most may survive less than a day or two in nature, but some live longer in the laboratory (Hedlin 1961, Peña et al. 1989, Rosenheim et al. 2007). Females usually die soon after they deposit their eggs (Möhn 1961b, Teetes 1985). Larvae are much longer-lived than adults and subject to many more environmental dangers as well as risk from parasitoids and predators (Redfern & Cameron 1978, Soné 1986a).

Parasitoids

Parasitoids of cecidomyiid larvae are mostly Hymenoptera, especially of the families Platygasteridae, Pteromalidae, and Torymidae, less commonly Ceraphronidae, Encyrtidae, Eupelmidae and Eulophidae and, more rarely, Braconidae and Ichneumonidae. Parasitoids may be either generalists with a wide host range or specialists on one or more species of gall midges (Hawkins & Goeden 1984, Yukawa, Matsuo & Fujii 2021). Hymenoptera and other inhabitants of cecidomyiid galls have been surveyed, including by Askew & Ruse 1974, Baxendale et al. 1983, Coutin & Katlabi 1986, Frankie et al. 1987, Hawkins & Goeden 1984, Neiswander 1962, Parnell 1964, Roskam 1979, 1986, Soné 1986b, Sunose 1984, Yukawa 1983, and Yukawa et al. 1981. Parasitism rates can be very high: a pteromalid parasitized 24-45% of a population of Japanese *Asphondylia morivorella* (Naito) (Sunose 1983a), and two species of *Platygaster* killed 50% of a population of *Contarinia coloradensis* Felt (Brewer & Johnson 1977).

Asteromyia carbonifera (Osten Sacken) lays eggs in small to large clutches that result proportionately in one or more larval chambers per gall. In galls with two or more larvae, not all larvae are parasitized because the parasitoid visiting the gall does not oviposit in each of the chambers. The possibility of death through parasitism increases in galls with only one larva because parasitoids visit galls randomly, whatever the size. Yet females of *A. carbonifera* reared from galls with a single larva are usually larger and bear more eggs (Weis 1982a, 1982c).

Some parasitoids, particularly egg-larva parasitoids, have extremely close relationships with their hosts. *Platygaster pini* Fouts (Platygasteridae) oviposits in eggs of *Cembrotia coloradensis* (Felt) on pinyon pine needles, but the parasitoid does not begin growing until the gall midge larva is fully developed in spring of the following year. The *Platygaster* larva then develops quickly to appear as an adult shortly after host gall midges normally emerge (Brewer 1971). Roskam (1986) shows similar cases of European *Platygaster* spp. on birch gall midges.

Predators

Among the major predators of gall midge larvae are cecidomyiids of the genus *Lestodiplosis*, which prey on cecidomyiids in both simple and complex galls and in flower heads (Neal & Gott 1988, Neiswander 1962, Nijveldt 1969, Gagné & Moser 2013). Other Diptera predators include larval Phoridae that feed in galls of gregarious cecidomyiids (Robinson 1971, Robinson & Brown 1993) and adults of Empididae that catch gall midges in flight (Stark & Wetzel 1987). Cicadellidae (Hemiptera) and Reduviidae, Nabidae and Miridae (Heteroptera) have been found feeding on larvae and pupae directly through gall tissue and also upon pupae breaking out of their galls (Jones et al. 1983; Yukawa 2021). Beetles, caterpillars, ants, harvestmen and spiders also feed on gall midges

(Yukawa & Kim 2021, Yukawa 2021). A mite (*Pyemotes herfsi* (Oudemans) (Acari: Pyemotidae) was found on *Contarinia* larvae in pin oak leaf galls in such numbers that they caused mite bite outbreaks on humans who passed beneath the trees (Broce et al. 2006).

Vertebrates, too, can be predators. Some branches of an elm that suffered a heavy infestation of *Dasineura ulmea* Felt had every bud, infested or not, torn apart by birds searching for larvae (pers. obs.). Needle galls of *Paradiplosis tumifex* Gagné were pecked by birds (Struble & Osgood 1976). In Europe, birds break into stems of reed (*Phragmites*) to pick out gall midge larvae (Skuhravý 1981). Rodents eat succulent galls that are close to the ground (Spence 1969).

Fungi also may take a toll on larvae. An epidemic of *Entomophthora brevinucleata* (Zygomycetes: Entomophthoraceae) killed many gall midges on grasses in Europe in 1983 (Keller & Wilding 1985).

Intra- and Interspecific Competition

Several larvae of *Cembrotia* sp. on pinyon pine enter a particular fascicle bundle, but only one larva per fascicle reaches maturity (Gillet & Brewer 1983). Crowding of individual galls of *Contarinia oregonensis* in Douglas-fir cone scales results in smaller adults and, presumably, reduced fecundity. Whole cone scales died when larval density was very high (Miller 1984). Competition with other arthropods for the same tissue has been noted between mites and the gall midge *Taxomyia taxi* (Inchbald) on yew in England (Redfern & Cameron 1978) and between a lepidopteran and *Hasegawaia sasacola* Monzen on bamboo in Japan (Sunose 1978).

Inquilines

An inquiline is an organism that can be found in galls but is not the gall former. Inquilines of cecidomyiid galls include gall midges and other arthropods. The habit is widespread among Cecidomyiidae. Although most species of *Dasineura* and *Contarinia* are gall formers, both genera include inquilines. Some genera are wholly inquilinous, including *Trotteria*, whose species live in galls mostly made by *Asphondylia* where they indirectly kill the gall maker through competition (Parnell 1964). *Parallelodiplosis* includes species that are fatal inquilines in galls of both *Caryomyia* spp. and *Celticecis* spp. (Gagné 2008, Gagné & Moser 2013). Certain inquilines arrive late in the gall cycle, often after the gall maker has departed. A group of several *Lasioptera* species in North America and Japan is associated with spent galls of cynipine oak wasps (Gagné 1989) and the European *Lasioptera donacis* Coutin & Faivre-Amiot is associated with fungi growing in old galleries of a chloropid fly in leaf sheaths of *Phragmites* (Coutin & Faivre-Amiot 1981)

The effect on the gallmaker of some cecidomyiid inquilines may be benign, particularly if they live in the outer leaves of rosette galls on such plants as willow and spirea and never influence gall development or have contact with the gall maker in the central chamber. Other inquilines not only compete with the gall maker for space and food but can even modify the gall. *Dasineura balsamicola* (Lintner) an inquiline in balsam fir needle galls formed by *Paradiplosis tumifex* Gagné, is always fatal to the gall maker and even affects gall development (Osgood & Gagné 1978, Shorthouse & West 1986). Needles galled by *P. tumifex* normally drop from the tree in autumn soon after the full-grown larvae drop to the soil, but needles with the inquiline remain on the tree until the slower growing larvae of *D. balsamicola* become full-grown (Osgood & Gagné 1978). An unnamed

Contarinia species in Europe colonizes flower galls of *Gephyraulus diplotaxis* (Solinas) when larvae of the latter begin to leave the galls. The *Contarinia* then takes control of the gall, causing it to change shape and remain viable longer (Solinas & Bucci 1982). *Tetrastichus* wasps (Eulophidae) lay eggs in *Asphondylia* galls and encapsulate themselves in spherical chambers within the gall tissue. As the larval wasp chambers grow, they gradually constrict and kill the *Asphondylia* larva (Hawkins & Goeden 1982, Dorchin et al. 2015).

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Other Mortality Factors

In addition to parasitoids and predators, accidents and weather can affect survival: eggs are laid on the wrong host or an unsuitable part of the plant, or they do not adhere; larvae die before reaching susceptible tissue; adults emerging from the ground in late winter encounter strong winds that drive them out of range of their hosts (Gagné 2002). Not least of all, plant toxins can kill gall midge eggs and larvae (Åhman 1986).

Fungal Associations

Many Cecidomyiinae are primitively obligatory fungivores. Most of those cecidomyiids are outside the scope of this book, but some, e.g., *Mycodiplosis* spp., are referred to in the text because they graze among rusts and mildews growing atop plant surfaces. *Karshomyia caulicola* (Coquillett), can be found feeding on white mold in stems of various agricultural commodities (Koch et al. 2020).

Symbiotic Fungi.

Fungal symbionts are regularly present in galls of three disparate tribes of Cecidomyiinae, the Asphondyliini of the supertribe Cecidomyiidi and the Lasiopterini and Alycaulini, both of the supertribe Lasiopteridi. The fungus appears as a white mycelium lining the inside of the gall while the larva is actively feeding, after which the fungus turns gray or black. The symbiont appears to be obligatory in galls where it occurs but is not universally found in galls of the separate tribes or genera. Most species of *Asteromyia*, an alycauline, have a symbiont, but at least *Asteromyia modesta* (Felt) on fleabanes has none (Gagné 1968a). Of two species of *Lasioptera* in separate galls on joint fir, only one has a symbiotic fungus (Herman et al. 1983).

Symbiotic fungi in the three tribes of gall midges belong to variants of *Botryosphaeria dothidea* (Botryosphaeriaceae) (Bissett & Borkent 1988 (as *Macrophoma*), Adair et al. 2009, Heath & Stireman 2010, Kobune et al. 2012 and Lebel et al. 2012). This is an adaptable fungus that is also considered to be the causal agent of rot in various fruit and cankers of woody plants (Lebel et al. 2012). The gall midge larvae are thought to feed on the fungus, at least during part of their lives, if only because certain of those galls appear to lack plant-generated nutritive tissue (Meyer 1984, 1987, Rohfritsch 2008). Many questions about symbionts, including transfer of spores, remain unresolved.

Cecidomyiid Galls on Fungi

Galls on fungi made by gall midges consist of simple outgrowths and are extremely rare. They are made by species with no connection to phytophagous cecidomyiids. Only one is known so far from North America in the form of simple swellings on mats of *Hydnochaete olivaceus* (Basidiomycota: Hymenochaetales: Hymenochaetaceae) found on oak twigs in Massachusetts by H. Nadel and C.E. Eiseman (unpub.). Each swelling covers a closed chamber that bears one to several orange larvae. The gall midge responsible is an undescribed species of *Cassidoides* that belongs to the Porricondylinae, a subfamily whose habits are entirely fungivorous.

Reported here for the sake of completeness are three other cecidomyiids, all Cecidomyiinae, that have been found elsewhere from galls on fungi. Two of them, *Mycocecis ovalis* (Edwards), on *Hypoxylon rubiginosum* (Xylariales: Xylariaceae) (Evans 1970) and *Brachyneurina peniophorae* Harris on *Peniophora cinerea* (Russulales: Peniophoraceae) (Harris & Evans 1979), are known from the United Kingdom. The third, *Ledomyia collarata* Gagné, found on *Xylaria enterogena* (Xylariales: Xylariaceae) is known from Venezuela (Larew et al. 1987). These three species have no apparent close relationship to one another. The first belongs to the supertribe Cecidomyiidi and the second and third belong to separate tribes of the supertribe Brachineuridi (Gagné and Jaschhof 2025).

4 Synopsis of North American Genera of Cecidomyiinae Associated with Plants

These notes on the genera mentioned in this book will place individual keyed species in larger context. The genera are in alphabetical order. Information about their classification can be found in Appendix 1 of Gagné and Jaschhof (2025). Drawings for Chapter 2 on anatomy are referenced here and literature that might be informative is cited. One phytophagous genus, *Xylodiplosis*, has its own paragraph for completeness, but is mentioned nowhere else in the book. Species in this genus live in xylem vessels of freshly cut wood of many deciduous trees.

An illustrated generic key to adult Cecidomyiinae can be found in Gagné (2018a). A non-technical key to larvae of Nearctic genera based mainly on hosts appeared in the first edition of this book (Gagné 1989); the present synopses with reference to individual plates must serve the purpose here. Some out-of-date technical keys to larvae of European gall midge genera may also be helpful. These are by Möhn (1955) and Mamaev and Krivosheina (1965). The study by Sylvén (1975) on Palearctic Lasiopteridi should also be helpful.

Acericecis. This genus has four extant species, one North American, three European and one Miocene fossil from Oregon. All form simple leaf galls on maples. The extant American species lives in a glutinous substance in a slight circular depression on the underside of the leaf lamina. Larval features are shown on Plates 2 and 5. Gagné 1983b, Skuhravá and Skuhravý 1986.

Ametrodiplosis. Six species are known from North America and 26 more in Eurasia. The genus is found in flower and bud galls on unrelated plant families. An important distinguishing character of this genus is the basally swollen male costal vein. Gagné 2018b.

Ampelomyia. This genus includes four species, three from North America and one from Japan, all forming complex galls on grape. They were placed until recently in *Schizomyia*. Larval features are shown on Plate 17. Elsayed et al. 2019.

Anthodiplosis. This genus has two species, one in Europe, the other in North America. The latter, *Anthodiplosis eutrochii* Gagné, forms bud galls on Joe-Pye weed. The more obvious distinguishing adult character of this genus are the setulose necks of the flagellomere necks of both sexes and the presence of only two circumfila on each male flagellomere. Gagné 2016a.

Aphidoletes. This genus contains four species, all predators of aphidoids. Free-ranging larvae of one of them, *Aphidoletes apidimyza* (Rondani), are commonly found throughout the season among aphid colonies. Larval features are shown on Plates 2 and 16. Harris 1966.

Arnoldiola. Of 16 species in the Holarctic Region, five are Nearctic, of which one is associated with bud galls on live oak, another with burrlike petiole galls on American chestnut. The remaining three Nearctic species were caught in flight. The Palearctic species are from Europe and Kazakhstan and mostly associated with oaks. The main differentiating character is the conspicuously broadened male tarsi. Gagné 2009a.

Arthrocnodax. A cosmopolitan genus of 49 species, its species are almost exclusively predaceous on gall-forming mites (Acarina: Eriophyidae). The genus is mentioned here because adults have occasionally been reared in association with cecidomyiid galls. Harris 2014.

Asphondylia. This is a large, cosmopolitan genus of 320 described species, 75 of them Nearctic. A further 63 unnamed Nearctic species are referred to in the keys. These form galls on a great number of plant host families, mainly in buds and reproductive organs. Most have a symbiotic fungus in the galls. Certain species are of economic importance, e.g. *Asphondylia websteri* Felt, found on various legumes and other plant families (Gagné & Woods 1988). Some species alternate generations seasonally between two organs of a single plant species (Dorchin et al. 2015), others alternate seasonally between or among unrelated plants (Gagné and Orphanides 1992, Yukawa et al. 2003, 2021). Many species groups within this genus are the result of radiation on certain plant genera, e.g. saltbush (Hawkins et al. 1986), creosote bush (Gagné & Waring 1990) and goldenrod (Dorchin et al. 2015). Females have a long, stiff, needle-like ovipositor modified for laying eggs inside plant tissue. See larval, pupal and adult anatomical features on Plates 3, 17, 18 and 20. Möhn 1961, Richter-Vollert 1964, Yukawa et al. 2021.

Asteromyia. Nine described species of this North American genus are known, all restricted to the tribe Astereae (Asteraceae). Biological differences evident within the *Asteromyia carbonifera* (Osten Sacken) complex on goldenrod (Weis 1982a, Stireman et al. 2008, 2010 & 2012, Heath & Stireman 1910) and additional undescribed species found on *Baccharis* (Gagné and Boldt 1995) suggest that previously made synonymies (Gagné 1968a) should be reassessed. Most species are responsible for blister galls on leaves and green stems. One exception is *Asteromyia tumifica* (Beutenmüller) that forms a swelling near the base of goldenrod stems. Most species have a fungal symbiont that eventually forms a black, hard cast surrounding full-grown larvae. Larval features can be seen on Plate 8. Gagné 1968a, 1969b.

Astictoneura. This genus contains one species, *A. muhlenbergiae* (Marten), that causes an imbricated, broomlike stem gall on *Muhlenbergia* spp. Galls resemble those made on other grasses by some *Chilophaga* spp. Gagné 1969b.

Asynapta. This cosmopolitan genus of 49 species belongs to the subfamily Porricondylinae and is associated with rot. It is included here because a few species have been found in living plant organs, including pine cones, where they were presumably associated with rot. A larva is drawn on Plate 3. This genus and *Camptomyia* are the only non-cecidomyiines referred to in the keys to galls. Jaschhof and Jaschhof 2013.

Blaesodiplosis. This Nearctic genus of three described species is responsible for leaf galls on shadbush and hawthorn. Larval features are shown on Plate 14. Gagné 1973b.

Brachineura. This cosmopolitan, mycophagous genus of 31 species includes Eocene fossils. One species, *Brachineura vitis* Felt, was reared once with succulent galls on grape caused by other gall midges. It is presumably a secondary feeder.

Bruggmannia. The 19 species placed here are an endemic Neotropical group and responsible for woody, blisterlike leaf galls on various plant families, mostly Nyctaginaceae. Only two species are known from our range, from southern Florida and Mexico on *Pisonia*. Larvae are notable for their elongated, tapered terminal segment, as shown on Plate 17. Möhn 1962.

Bruggmanniella. This genus of 22 species is mainly Neotropical but extends into the Asian-Pacific Region. They are gall makers on diverse plant families and include *Bruggmanniella perseae* Gagné, a pest of avocado in Costa Rica and Colombia. *Bruggmanniella bumeliae* (Felt) occurs in southern United States on *Bumelia lanuginosa* and another, undescribed species has been found on *Adenostoma fasciculatum* in California. Garcia, Lamas & Urso-Guimarães 2020, Lin, Tokuda & Yang 2020.

Calamomyia. This North American genus contains 19 described species. All presumably live in stems of grasses, but only seven have been associated with particular hosts that are distributed

among five tribes of Poaceae. Most of the remainder were caught in flight and are each known from a single specimen. Two distinct species live on separate species of *Spartina*, so the actual number of species in this genus must be great. Larvae may be single or gregarious in the culms. Full-grown larvae form individual silken cocoons in the stems where they pupate. Adults of some species have been reared in fall, others in spring. Infested grasses usually show no external sign of damage until late in the season when their fungal associate shows through the culms as a black discoloration. Infested stems are weakened and break easily in winter. Some larval features are shown on Plate 8. Gagné 1969b.

Camptomyia. This cosmopolitan genus of 73 species is mycophagous. Larvae of many are found under dead bark of trees and a few live among scales of conifer cones where they presumably feed on fungi. This genus and *Asynapta* belong to Porricondylinae and are the only non-cecidomyiines in the keys to galls. See Plate 5 for some larval features. Jaschhof and Jaschhof 2013.

Camptoneuromyia. Six Nearctic and nine Neotropical species are known and may all be inquilines in galls caused by other organisms, mainly cecidomyiids (Möhn 1975). Larvae pupate in or near the galls. An undetermined Nearctic species was observed feeding on mycelium growing immediately below the epidermis of *Asteromyia carbonifera* (Osten Sacken) galls on goldenrods and another was reared from galls of the cynipid wasp *Neuroterus fragilis* Bassett. Gagné 1969b, Möhn 1975, Weis 1982b.

Cartodiplosis. This genus contains one species, *C. nyssaecola* (Beutenmüller), a predator of *Phylloxera nyssae* (Hemiptera: Phylloxeridae) in a marginal leaf roll on sour gum. Part of a larva is shown on Plate 16. Gagné 1973b.

Caryadiplosis. This genus is known from two species from eastern North America that form simple leaf galls on hickory. Gagné 2008.

Caryomyia. The 56 species in this Nearctic genus are responsible for complex leaf galls on hickory. Each species has a single generation per year and pupates in its gall on the ground the following spring. Most species are associated with the *Eucarya* section, one of two sections of *Carya*. Species do not appear to differentiate among the various species within a section. The ovipositor is short and has a rigid dorsal sclerite. The second instars of almost all species have a spatula. Larval characters are shown on Plate 12. Gagné 2008.

Cecidomyia. This Holarctic genus is known from 19 species, 10 of them Nearctic. All feed on resin of conifers, mainly pine. Larvae usually live fully immersed in resin except for their enlarged hind pair of spiracles that protrude through the surface. The species of one section of the genus are gregarious and, when fully fed, pupate in silk-lined tunnels in the resin mass. Species of the other section are mainly solitary and their full-grown larvae crawl away from the feeding site to pupate on a needle or branch in a white cocoon. Distinctive larval characters can be seen on Plates 4 and 11. Gagné 1978b, Nijveldt 1987, Gagné & Hibbard 2008.

"**Cecidomyia**." Many species were formerly placed for convenience in *Cecidomyia*. The genus served to gather unrelated species that did not fit in named genera, were incompletely known, or described only from their galls. "*Cecidomyia*" *lappa* Stebbins, e.g., is presently known only from its larval stage and very prominent gall on spirea.

Celticecis. This genus is widely represented in the eastern Nearctic Region by 21 species. It is known so far in the Palearctic from one species in Turkey and three in Japan. Oddly, none are known from Europe. All form complex, dehiscent, leaf and stem galls on hackberry. This is one of only a few genera of gall midges in which second instars have a spatula. See Plate 5 for some larval features. Gagné & Moser 2013; Gagné & Doğanlar 2013, Sato & Yukawa 2023.

***Cembrotia*.** One described species, *C. coloradensis* (Felt), and at least two unnamed species

from the southern Rocky Mountains make up this genus. They are responsible for needle-shortening galls on pinyon pine and relatives (*Pinus*, section *Cembroides*). As in many other gall midges on conifers, the empodia are much longer than the tarsal claws. See Plate 6 for larval features. Gagné 2013.

Chamaediplosis. Two western Nearctic species that form galls on shoot tips of *Cupressus* spp. make up this genus. Adults show a resemblance to *Contarinia*, except in the short ovipositor with its more bulbous cerci. Gagné & Duncan 1990.

***Chilophaga*.** This North American genus contains six species that live gregariously in foreshortened grass tillers. *Chilophaga tripsaci* (Felt), has been found feeding in stems of maize in Mexico. Larval features can be seen in Plate 8. Gagné & Figueroa 2022.

Chiosperma. One species is known, a bud gall maker on snowberry, in western North America. Gagné 2016c.

Clinodiplosis. This is a very large, cosmopolitan genus of over a hundred described species in the World, 43 of them Nearctic. Many more unidentified species are referred to in the keys. It is a catch-all category for its tribe. Some species, especially in the Americas, are primary plant-feeders and gall makers. Others are apparently fungus-feeders, still others facultative or obligatory predators. Larvae are commonly found in many niches; Eiseman (2025a) lists several randomly reared specimens found in the course of his work with leaf mines. Skuhravá (1973) showed that some European species are generalists in flower heads. There is evidence that inquilinous species may be generalists, e.g., the *Clinodiplosis* sp. that emerges in spring from galls on staminate flowers of sour gum made by a univoltine *Contarinia* sp. Larval features for the genus can be seen on Plates 2 and 15. Gagné et al. 2000, Gardner et al. 2018.

Coniophora. Five Palearctic species are nominally placed here. *Coniophora graminicola* Nijveldt, the only one that strictly belongs to the genus, lives in glumes of the grass *Phalaris arundinacea*. It was found in The Netherlands and only recently discovered in South Dakota. Whether this is a native or immigrant is unknown. Perilla & Johnson 2018.

Contarinia. With 320 described species, 60 of them Nearctic and 85 more undescribed North American species listed in the keys, this cosmopolitan genus serves as a catch-all category for most Cecidomyiidi with elongate ovipositors and dorsoventrally flattened, closely adjacent cerci. Most species are gregarious in flower heads or leaf roll galls and leave the host to pupate in the ground. Some have several generations per year. A few are known to be polyphagous, most notably the Asian *Contarinia maculipennis* Felt that feeds gregariously in apical buds of several agricultural commodities in unrelated plant families. That species has been reported from Florida and California, but is not known to be established. See larval, pupal and adult anatomical features of various *Contarinia* species on Plates 2-3, 9-10, 18 and 20. Harris 1966, Gagné 1995b, Uechi et al. 2003.

Craneiobia. One Nearctic species, *Craneiobia tuba* (Stebbins), and one Palearctic species are placed here. Both form tubelike galls on leaves of dogwood.

Ctenodactylomyia. This genus is known from two species that form hard blister galls on leaves of *Coccoloba* (Polygonaceae). One, C*tenodactylomyia watsoni* Felt, occurs in Florida, the other in Cuba. They are very likely synonymous. See larval features on Plate 12.

Cupressatia. This genus comprises two species found in seeds of western North American Cupressaceae. One of them, *Cupressatia siskiyou* (Felt) on Port Orford cedar (*Chamaecyparis lawsoniana*), was long ago introduced into Europe with its popular tree host. See larval features on Plate 6. Gagné 2013.

Cystiphora. All seven species of this Holarctic genus live in leaf and stem blister galls of the dandelion tribe Cichorieae. One species is native to North America and six to Europe. Two of the

European species have been purposely introduced into western North America for the control of noxious range weeds. One other species discovered on dandelion in western Canada was apparently accidentally introduced. Larvae pupate in the galls. The female eighth segment is bulbous and the short ovipositor is tapered abruptly to a sharp point. Eggs are inserted individually into stomatal openings on the underside of leaves (DeClerck and Steeves 1988).

Dasineura. This is a large cosmopolitan genus of 493 described species of which more than 100 are known from North America. Many species remain undescribed, including the 68 additional taxa listed in the keys only as *Dasineura* sp. This broad definition allows us to use *Dasineura* as a temporary home for species that cannot be placed elsewhere. The genus may eventually submit to being broken down by host groups. As a large, diverse genus, *Dasineura* exhibits diverse habits. Many species live freely in flower parts or make simple leaf rolls or folds. When larvae are full grown, at least in the temperate zones, they drop to the soil. The last generation of the season diapauses, pupates in spring, followed by adult emergence. Some species form complex galls and others are inquilines that require another cecidomyiid to initiate a gall on a particular host. Several immigrants in North America were accidentally introduced with their hosts, including at least two on grasses and two on clovers. *Dasineura* fits a general morphological aspect with some variation. One oddity is the tooth at the base of the tarsal claws that is absent from some species on grape. See larval, pupal and adult anatomical features on Plates 1, 5, 9 and 21. Sylvén 1975, Sylvén & Tastás-Duque 1993, Gagné et al. 2014, Dorchin et al. 2019, Gagné et al. 2024.

Diadiplosis. A cosmopolitan, chiefly tropical genus of 34 species, its larvae are predators of whiteflies and scale insects. Harris 1968, Gagné 1994.

Edestochilus. The unique species, *E. allioides* (Pritchard), causes a bulblike basal swelling on stems of the grass *Paspalum distichum* in California. Gagné 1969b.

Edestosperma. This genus contains only one species, *E. aristidae* Gagné, from seeds of the grass *Aristida longiseta* (Poaceae) in Idaho. Gagné 1969b.

Endaphis. This is a cosmopolitan genus of 11 species that are internal parasitoids of aphids and other Hemiptera and Heteroptera. Gagné & Etienne 2019.

Feltiella. This genus is known from 11 species whose larvae are predators of red spider mites (Tetranychidae). Larvae may be found free ranging in mite galls as well as elsewhere on plants. A drawing of the hind end of a larva can be seen on Plate 16. Gagné 1995a.

Ficiomyia. The monotypic *Ficiomyia perarticulata* Felt lives in figs in southern Florida and the West Indies. This genus is quite distinct from other American Lasiopteridi. It has antennae of more than 30 flagellomeres, very large eyes, reduced mouthparts and body and wings patterned with dense, alternately light and dark patches of scales. Roskam & Nadel 1990.

Gephyraulus. This Palearctic and Asian genus is known from 15 species, mostly from flower galls on various Brassicaceae in Europe. A striking modification of the genus is the bilaterally compressed ovipositor with its hardened, glabrous, fused cerci. The genus is included here because *Gephyraulus mangiferae* (Felt), introduced with mango into the West Indies and Hawaii, may one day be found on mango in North America. Sylvén & Solinas 1989, Gagné & Etienne 2006, Elsayed & Kawakita 2022.

Giraudiella. Two Palearctic species are known, one each in culms of a sedge and a grass. The one on grass, *G. inclusa* (Frauenfeld), is an immigrant in eastern North America on the European form of *Phragmites australis*. Skuhravá and Skuhravý 1981.

Gliaspilota. Larvae of the single known species, *G. glutinosa* Gagné, have conspicuous dorsal abdominal lobes and very long setae, presumably modifications for life in a glutinous substance in slight depressions on the undersides of leaflets of hickory. The male is still unknown,

but the female has a short-protrusible ovipositor and dissimilar tarsal claws that are irregularly toothed. Larval features are shown on Plate 13. Gagné 2008.

Harmandiola. Seven of the 14 species of this Holarctic genus are Nearctic. In North America, one occurs on hickory, two on chestnut and the remaining four on poplars. All cause convex or spherical leaf galls. Several more, unnamed species are known from poplars. Larval features are shown on Plate 10. Gagné and Payne 1992b, Gagné 2008.

Helianthecis. This genus is known from one species, *Helianthecis capitum* Gagné, a gall maker on heads of sunflower. Gagné 2016c.

Horidiplosis. This Asian genus is known from seven species, all gall makers on leaves of figs. One of them, *Horidiplosis ficifolii* Harris, was found in The Netherlands and Florida in galls on imported fig plants intended for the bonsai trade. Harris & Goffau 2003.

"***Hormomyia***." A bud gall maker, "*Hormomyia*" *clarkei* Felt, on spirea was originally mistakenly placed under this genus where it does not belong. Adults have not been reared, so the generic placement for this species remains unresolved.

Hybolasioptera. The one named American species is known from central North America in stems of Virginia wild rye. One other species is known in Europe where it is a pest of several grain crops. The bilaterally flattened and strongly pigmented ovipositor is presumably used in inserting eggs into grass culms. An unidentified species has been reared from hay in Mexico. Gagné 1969b.

Hyperdiplosis. This is a cosmopolitan, catchall genus of 11 species, probably all mycophagous. Some are occasionally reared from plant material.

Hypogeadiplosis. This monotypic genus is known from *Hypogeadiplosis intrusa* Gagné, an inquiline found in rhizome galls made by *Ametrodiplosis recondita* Gagné on mountain mint. Gagné 2018b.

Isolasioptera. This genus is the southernmost example of the tribe Lasiopterini in the New World. It is known from two species described from El Salvador and an undescribed species from central Mexico. They occur in leaf vein swellings on *Eupatorium*. Möhn 1964b.

Iteomyia Kieffer. This genus is known from two Nearctic and three Palearctic species that form spheroid or conical leaf galls on willows. Russo (2021) shows galls of another two possible species.

Jaapiella. This is another catchall genus of 82 species, mostly European and western Asian, found on a diverse array of plant families. Two species have been introduced into western North America for the control of alien weeds: *Janetiella cirsiicola* Rübsaamen from thistles, *Cirsium* spp., and *Janetiella ivannikovi* Fedotova from Russian knapweed. A further species, *Janetiella gibsoni* (Felt), originally described from North America from specimens reared from the alien thistle, *Cirsium arvense*, is possibly a synonym of the European *Jaapiella cirsiicola* (Rübsaamen) from the same host. The difference between *Jaapiella* and *Dasineura* cited for European species is that the gonocoxite of *Jaapiella* is broadened posteriorly, which is not true for all species presently assigned to this genus (Sylvén & Tastás-Duque 1993, Sylvén & Lindberg 1998).

Janetiella. This is a diverse, catch-all Holarctic genus of 23 species reared from a wide assemblage of unrelated plants. Five Nearctic species are assigned to the genus, none with obvious relationship to the type species, the European *Janetiella thymi* (Kieffer). The main character used to separate these species from *Dasineura* is the lack of teeth on the tarsal claws, a loss that could have come about separately many times. Gagné 2009b.

Kaltenbachiola. This genus, an offshoot of *Dasineura*, contains two North American and one European species, all from cones of spruce. As for many genera associated with conifers, the empodia are appreciably longer than the claws.

Karshomyia. This is a large, nearly cosmopolitan genus of 51 spp., 15 of them known from North America. Some have been reared from mushrooms or decaying plant matter. *Karshomyia caulicola* (Coquillett), the only one mentioned in this book, may be originally from Europe, but was first discovered on an alien poppy in New Hampshire in 1895. It was more recently found associated with white mold on soybean in Quebec and upper midwestern USA. This species is widespread in Europe, found in The Netherlands on white mold in stems of beans and potatoes and in stems and pods of winter rape. Larval features can be seen on Plate 16. Gagné 1973a, Koch et al. 2020.

Lasioptera. This is a large, nearly cosmopolitan genus of 127 species. Only 31 species are known from North America and only one is known as far south as Nicaragua. They occur on diverse plant families and mostly in stem galls, almost always with a symbiotic fungal associate. A few live in leaf spots or fruit and several are successors in oak galls vacated by gall wasps (Hymenoptera: Cynipidae). Native American species are not known from grasses, although many Old World species are and include *Lasioptera hungarica* Möhn, a recent introduction into eastern North America on the invasive European race of common reed, *Phragmites australis*. *Lasioptera* currently serves as the catchall genus for Lasiopterini, as does the analogous *Neolasioptera* for the tribe Alycaulini. Larvae of both genera in woody stems may appear similar. These genera fill the same niche in woody stem galls in which the resemblance of the larvae in some species of both genera has presumably been driven by similar habits. See larval features in Plate 8. Gagné 1969b, Dorchin et al. 2019.

Lauthia. Seven of the 28 species of this worldwide genus are known from North America. Larvae of some live in xylem vessels of fresh-cut wood and occasionally emerge from wooden packing cases and shipping pallets from abroad. Others live in rotting vegetable matter and fungi. Gagné 1985.

Ledomyia. This is a worldwide genus of 27 species of which seven are known from North America. Larvae of several have been found exiting xylem vessels of recently-cut wood. Gagné 1985.

Lestodiplosis. This is a cosmopolitan and ubiquitous genus of 186 described species, 48 of them Nearctic. Larvae are predators of other arthropods, including gall midges. They are common inhabitants of flower heads and may be found inside galls. Eiseman (2025a) lists a number of reared specimens found in the course of his work with leaf mining insects. Larvae have larger heads and longer antennae than plant-feeders and are equipped with pseudopods. Adults often have spotted wings and, less commonly, banded legs. See larval features on Plates 3, 5 and 16. Harris 1968; Baylac 1986, 1987; Gagné & Havill 2020.

Leucecis. This genus is known from a single species whose larvae live in open, circular concavities on the underside of leaves of poplars. Gagné et al. 2026.

Lonicerae. Two species of this Nearctic genus are known from bud galls on honeysuckle in western North America. Gagné 2016c.

Lopesia. This is a diverse, nearly cosmopolitan, mainly Neotropical genus of 33 known species found on many plant families. Only one named species is known from our range, *Lopesia licaniae* Gagné, found in rhizome galls of licania, *Geobalanus oblongifolia*, in Florida. Gagné & Hibbard 1996.

Lophodiplosis. This Australian genus is comprised of five known species from paperbark. One, *Lophodiplosis trifida* Gagné, has been introduced into Florida for the control of alien paperbark. Purcell et al. 2007, Gagné et al. 2009.

Lygocecis. Four species are known of this Holarctic genus, two of them Nearctic, two Palearctic, all from woody stem galls of willow. These species have a strongly sclerotized, bilaterally

flattened, saw-like ovipositor, presumably used for inserting eggs into willow shoots. The spatula is very large, strongly sclerotized, with many teeth. See Plate 6 for larval features.

Macrodiplosis. This genus of 14 species is Holarctic and restricted to oak on which they form rolls and folds on fresh leaves in spring. Full-grown larvae soon drop to the soil where they diapause until the following year. Nine are known from the Nearctic, five of them from oak leaf galls, the remainder from specimens caught in flight. Larval features can be seen on Plate 14.

Macrolabis. This is a large, nearly entirely Palearctic genus of 62 species, mostly inquilinous in galls of other gall midges. They closely resemble *Dasineura* except that the male gonopods are almost bulbous. Only one species, *M. americana* Dorchin, is known from the Nearctic. It is an inquiline in galls of *Dasineura folliculi* Felt on goldenrod. Dorchin et al. 2006.

Massalongia. This Holarctic genus of six species is restricted to galls on birch. One species is known from North America from buds of paper birch. See Plate 14 for larval features. Elsayed et al. 2020.

Mayetiola. This is a chiefly Palearctic and mostly European and North African genus of 29 described species, all from culms of grasses. Three named species occur in the Nearctic, only one of them a native, the Atlantic coastal *Mayetiola ammophilae* Gagné. Another is the Hessian fly, *Mayetiola destructor* (Say), a major pest of wheat that was accidentally introduced onto Long Island, New York, with invading Hessian soldiers during the War for Independence (Fitch 1846). The third is *Mayetiola phalaris* Barnes, possibly an immigrant recently discovered in Iowa. Two additional but undescribed species have been found in Alaska. Unlike most cecidomyiids, the third instar does not feed. That instar and the pupa develop inside the skin of the second instar. The larvarium/puparium is dark brown and resembles a seed in shape. See Plate 19 for a figure of this stage. Gagné & Hatchett 1989, Gagné et al. 1991.

"***Mayetiola***" *californica* Felt. This species is from an unspecified gall on gooseberry in California. It does not properly fit into any known genus of Lasiopteridi.

Meunieriella. This genus of 22 species is mostly Neotropical and inquilinous, but the described Nearctic species forms blister galls on its host. Males have characteristic long, thin gonopods and their sixth through eight abdominal segments are retracted into the abdomen when at rest. Möhn 1975, Gagné and Valley 1984, Gagné & Etienne 1996.

Monarthropalpus. The one known species, *Monarthropalpus flavus* (Schrank), was accidentally introduced from Europe into North America with boxwood in the Colonial Period. Females have a short, hooklike ovipositor used for inserting eggs in young leaf tissue. Features of larvae and pupae can be seen on Plates 13 and 19. Baylac 1989.

Mycodiplosis. This is a large, cosmopolitan genus of 49 species that are commonly found feeding on spores of rusts and mildews on leaf surfaces. The North American species have not yet undergone comprehensive study, but the European fauna was revised by Holz (1970). Some of the European species are generalists and occur also in North America. See Plates 2 and 15 for larval features. Holz 1970.

Neolasioptera. This large, New World genus of 134 spp., 67 of them North American. They occur on a wide variety of plants, especially Asteraceae. Another 88 species are listed only as *Neolasioptera* spp. in the keys here. Most are associated with stem galls, but some are found in leaf galls and flower parts, including seeds. Galls of most species harbor a fungal symbiont. As with *Lasioptera* of the tribe Lasiopterini, *Neolasioptera* currently serves as the catch-all genus for Alycaulini. Larvae of both genera that live in woody stem galls appear remarkably similar. Larvae in woody stems usually have especially robust spatulas that are used to cut an exit channel. In some species, an exit channel is predetermined by the initial path of entry but others dig several exits

from the gall. At least one species, an undetermined species reared from galls of *Lasioptera ephedricola* Cockerell on *Ephedra*, appears to be an inquiline. For larval, pupal and adult features see Plates 4, 8, 19 and 21. Gagné 1994a, 2018a; Dorchin et al. 2019.

Obolodiplosis. This genus is known from one eastern Nearctic species, *O. robiniae* (Haldeman), that causes a marginal leaf roll on black locust. It was introduced with its host into Europe where they are now both commonly found. For larval features see Plate 12.

Oligotrophus. This genus contains 10 species, three of them Nearctic, that form galls on branch tips of juniper. The genus shows some affinities to *Walshomyia*, which is also specific to juniper. Gagné & Valley 1984.

Olpodiplosis. The one known species, *Olpodiplosis helianthi* (Brodie), causes tubular stem galls on sunflower. For larval features see Plate 14. Gagné 1973b,

Onodiplosis. This genus contains one Nearctic species, *Onodiplosis sarcobati* Felt, that forms bud galls on *Sarcobatus* in western North America. Dorchin et al. 2021.

Ozirhincus. One immigrant species from Europe is known in North America where larvae live in achenes of yarrow. Four other species are known from Europe; all five live in achenes of Anthemideae (Asteraceae). They have distinctive long mouthparts and associated adaptations of the head and thorax. These modifications presumably allow for feeding in flowers of their hosts, although that has not been demonstrated. Dorchin et al. 2015.

Paradiplosis. Four species are known in this genus, two from North America, one from Europe and one from Japan. They cause needle galls on fir and spruce. For larval features, see Plate 11. Osgood and Gagné 1978.

Parallelodiplosis. This is a nearly cosmopolitan genus of 20 species. Twelve of them are Nearctic and include both gall makers and fatal inquilines of gall makers of various insect orders. For larval features see Plate 15. Gagné 2008, Gagné and Moser 2013.

Peracecis. The single species, *P. fugitiva* Gagné, causes simple hemispherical leaf galls on hackberry. Gagné and Moser 2013.

Piceacecis. Two species occur here, both in shoot galls of spruce. One is native to North America, the other to Europe and a recent arrival in eastern North America. Gagné & Graney 2014.

Pilodiplosis. This genus is known from one Nearctic species, *Pilodiplosis helianthibulla* (Walsh), that makes woody, convex swellings on leaves of sunflower. See Plate 13 for some larval features. Gagné 1973b

Pinyonia. This genus is known from one species, *P. edulicola* Gagné, found in needle galls of pinyon pine. Gagné 1970a.

Pisoniamyia. This a Neotropical genus of three species, all on *Pisonia*, of which one is known from northeastern Mexico. Möhn 1960b.

Pitydiplosis Gagné. Two species are known, a Nearctic species from an unknown niche on pine and a Japanese species on a legume. Gagné 1973b, Yukawa et al. 2012, Yukawa et al. 2021.

Planetella. This is a large Holarctic genus of 64 species. Those whose hosts are known live in basal stem swellings of *Carex* and *Cyperus*. The sedge host of only one of the 22 described Nearctic species is known. Adults are generally very large, their bodies sometimes longer than 10 mm, and most have the thorax produced anteriorly over the head. Antennae are remarkable in that they may each have 13 or more flagellomeres, unlike the usual 12 of most other Cecidomyiidi. Larval features can be seen on Plate 12. Ševčik et al. 2023.

Plemeliella. Undescribed North American species from seeds of fir and spruce are tentatively placed here. The genus is based on the Palearctic *Plemeliella abietina* Seitner, also from spruce seeds. Seitner 1908.

Polystepha. This genus is known from 18 nominal species from North America east of the Great Plains, two from El Salvador and three from Europe. Nine Nearctic species have been associated with particular galls. All are univoltine and cause blister or pill-like leaf galls on oaks. See Plate 17 for larval features. Möhn 1960b.

Primavera. The unique species, the Nearctic *Primavera porrecta* (Felt), attacks elm flowers. It is distinctive for its elongate R_5 wing vein and pulvilli, long male flagellomere necks and general lack of scales on the abdominal sclerites. See Plate 7 for larval features. Gagné 2002.

Procontarinia. Sixteen Asian species are known, all associated with mango. *Procontarinia mangiferae* (Felt), is an immigrant in the West Indies and Brazil, but not yet known from North America. Gagné 1994, Kolesik et al. 2017.

Procystiphora. This is a Holarctic genus of six species, three of them Nearctic, that live in culms of Cyperaceae, Juncaceae and Poaceae. Females have a bilaterally flattened, strongly sclerotized ovipositor. See Plate 5 for larval features. Gagné 1975b, Meyer 1984.

Prodiplosis. This Holarctic and Neotropical genus is known from 12 species, nine of them Nearctic, two of which have a wide range of hosts and are far-ranging in both North and South America. All form simple leaf rolls or live freely in flower heads. Larvae and females resemble those of some *Contarinia* spp., so males must be reared to confirm the generic identity. Males have a long, dorsally recurved aedeagus and gonopods that are dorsoventrally instead of mesolaterally articulated. Gagné 1986b.

Protaplonyx. The one known species, *P. sarcobati* (Felt), forms blister galls on leaves and green stems of *Sarcobatus vermiculatus* in the Great Basin. Its ovipositor is cultriform. Gagné 1969b.

Psectrosema. This genus of 26 Palearctic species, all gall formers on tamarix, does not yet occur in North America. One or more species may eventually be introduced to aid in the control of alien tamarix in the Southwest. Gagné et al. 1996.

Putoniella. This genus is known from two species, the Nearctic *P. gracilis* Gagné and one Palearctic species, both from leaf galls on *Prunus*. Gagné & Payne 1992a.

Rabdophaga. This is a large Holarctic genus of 77 species, 37 of them Nearctic. All are found on willow, except for three on poplar. The Palearctic fauna has received much more attention than that of North America. Many form woody stem swellings that on other plants in North America are most often the domain of *Neolasioptera*. Pupation takes place in the galls. Body size and number of flagellomeres can vary greatly in at least one species, *Rabdophaga rigidae* (Osten Sacken), characteristics that appear dependent in part on the host species and vigor (Smith et al. 1983). The bud gall makers of this genus are distinct from the stem gall makers. Bud gall makers are generally larger and have shorter ovipositors and spatulas. Larval features can be seen on Plate 6. Nijveldt and Yukawa 1982, Stelter 1982, Yukawa et al. 2021.

*"**Rabdophaga**" **cephalanthi*** Felt. This species, from stems of buttonbush, does not properly fit into any known genus of Lasiopteridi.

Resseliella. This cosmopolitan genus of 56 species, 15 of them Nearctic, is a remarkably homogeneous group. Larval niches are quite varied, including in and among flowers, beneath bark, in stems, among scales of pine cones and in simple leaf galls. Some species may be inquilinous. Tarsal claws are unlike those of other genera of Cecidomyiini. They are strongly angled at their basal third and usually have a basal tooth. The ovipositor is long and telescoped. Third instar larvae are robust and have two recurved lobes on the terminal segment as shown on Plate 11. Gagné et al. 2019.

Rhizocecis Gagné. The single known species, *Rhizocecis rhois* (Coquillett), is responsible for tuberlike galls on aerial rootlets of poison ivy. Gagné 2013.

Rhizomyia. This nearly cosmopolian genus of 30 species, eight of them Nearctic, is

associated with decaying plant matter. Adults are occasionally reared from gall samples.

Rhopalomyia. This is a huge cosmopolitan genus of 267 spp., 84 of them Nearctic. Almost all in our range cause complex galls on the asteraceous tribes Anthemideae and Astereae. Larvae pupate in situ and adults depart the galls while the host tissue is still living. Females then lay their eggs on meristematic tissue of the same host or seasonal alternate hosts. In this genus, the larval spatula is almost always lacking, so the work of exiting the gall is done by the pupae, which mostly show a variety of cutting structures on the head. Pupal and adult features can be seen on Plates 18 and 22. Jones et al. 1983, Dorchin et al. 2009, Adair et al. 2024.

Ribesia. Two species are known of this genus, both on gooseberry, one of them in western North America, the other in Kazakhstan. Gagné 2016b.

Sackenomyia Felt. This is a Holarctic genus known from three Nearctic and two Palearctic species that form blister galls on leaves of viburnum. Larvae are very active when disturbed. The characteristic ovipositor is short, dorsally recurved and bilaterally flattened, an adaptation for inserting eggs into plant tissue. See Plate 6 for larval features. Gagné 2016b.

Schismatodiplosis. One species, the Neotropical *S. lantanae* (Rübsaamen) belongs here. It is a gall maker on lantana from Mexico south to Brazil. Gagné 1994.

Schizomyia. This is a large cosmopolitan, polyphyletic genus of 71 described species. Twelve described species are known from North America and several more are unnamed. They form mainly bud galls on many unrelated host families. Larvae of most drop to the soil to pupate. Adults may superficially resemble *Asphondylia* but female *Schizomyia* spp. lack the pair of cerci-like lobes at the end of the eighth abdominal segment. The ovipositor is fine, pliable and usually longer than the abdomen. The usually bright red or orange larvae are very active when disturbed. See Plate 17 for larval features. Gagné and Menjivar 2008, Elsayed et al. 2018, 2019.

Semudobia. All seven species of this Holarctic genus are associated with bracts or seeds of birch. Five occur in our range, two of them immigrants introduced from Europe with seed of ornamental birches. See Plate 7 for larval features. Roskam 1977, Roskam & Van Uffelen 1981.

Sequoiomyia. This genus is known from two species, *Sequoiomyia taxodii* (Felt) in seeds of bald cypress in North America, the other in seeds of a Pliocene fossil on *Sequoia* in Germany. *Sequoiomyia* resembles *Taxodiomyia* in many respects but the ovipositor of *Sequoiomyia* is shorter and the cerci are separate. Gagné 1968b.

Sitodiplosis. This genus is known from three European species, one of which, *S. mosellana* (Géhin), is an immigrant in North America where it is one of the two most important cecidomyiid pests of wheat. Adults are among the more unusual Clinodiplosini for their bifilar flagellomeres. See Plate 15 for larval features. Gagné and Doane 1999.

Spurgia. Eight Palearctic species are known, all from bud galls of euphorbia. Two of them have been introduced into western North America from Europe for biocontrol of leafy spurge. Gagné 1990.

Stenodiplosis. This is a cosmopolitan genus of 15 species, all from florets of grasses (Poaceae). Many unrevised species of *Contarinia* from grass heads in Australia may belong here also. Six species are known in the Nearctic, three of them accidentally introduced from Eurasia or Africa. Most grasses may be found to harbor a species of this genus. See Plates 2 and 9 for larval features. Harris 1979, Ahee et al. 2013, Perilla et al. 2015.

Stephomyia. This is a chiefly South American genus of seven species, all from leaf galls on Myrtaceae. One species occurs in southern Florida. Among Asphondyliini, the ovipositor is the shortest and the cerci are discrete. Möhn 1961b, Maia & Barbosa 2018.

Strobilotia. This genus includes only *Strobilotia carpophaga* (Tripp) whose larvae live in

seeds of spruce. Gagné 2013.

Taxodiomyia. This eastern North American genus is known from three described and at least another seven unnamed species (Plates 95-97), all of which form galls on branchlets and needles of bald cypress. See Plate 15 for larval features. Gagné 1968b.

Thecodiplosis. Four Nearctic and two Palearctic species are placed here. All live at the base of pine needles, where they usually cause a swelling and prevent the needles from growing to their normal length. See Plate 10 for larval features.

Trotteria. This is a nearly cosmopolitan genus of 23 species, two of them Nearctic. Larvae are inquilines in galls of other cecidomyiids, chiefly *Asphondylia*. Larvae may be fatal inquilines if the gall-making larva is not fully enough developed when the *Trotteria* begins feeding (Parnell 1964). Larvae pupate in the galls. *T. caryae* (Felt) from North America was reared from galls of *Asphondylia monacha* (O.S.) and *Asphondylia thalictri* Felt. A unique behavior of the adults is carrying their hind legs outstretched behind them at rest so they do not touch the substrate. Möhn 1963, Parnell 1964.

Vaccinidiplosis. The single species in this genus makes a leaf gall on blueberry in eastern North America. Gagné and Payne 1994.

Vitisiella. The one Nearctic and two Palearctic species are known from leaf, twig and flower galls on grape. Several other undescribed Nearctic species are known. See Plate 7 for larval features. Gagné 2009b.

Walshomyia. This genus is known from five described and several undescribed western Nearctic species. All form galls on buds and fruit of various Cupressaceae. See Plate 6 for larval features. Gagné 1969a.

Xipholasioptera. This genus is known from one species with a sawlike ovipositor. It was reared in association with *Asphondylia baccharíola* Gagné from leaf fascicle galls on *Baccharis pteronioides* in Texas. Gagné & Boldt 1995.

Xylodiplosis. This genus contains three species, *Xylodiplosis longistylus* Gagné in North America and two more in Europe. Larvae live in xylem vessels of fresh-fallen wood from many kinds of deciduous trees, so no further mention is made of the genus in this book. Larvae become extremely long and thin within the vessels but quickly change into more usual dimensions upon exiting the vessels before burrowing into the soil to pupate. At that time larvae resemble those of *Contarinia*. Adults of *Xylodiplosis* also show some similarity to that genus. Gagné 1985, Rock & Jackson 1985.

Youngomyia. This is a genus of six species, two Nearctic, four Asian. One is *Youngomyia podophyllae* (Felt), a widespread inquiline or predator in galls made by other gall midges, especially *Schizomyia* spp., on a variety of plant hosts. See Plate 16 for larval features. Dorchin et al. 2015.

Zeuxidiplosis. The sole species, *Z. giardi* (Kieffer), originally from Europe, was introduced into western North America for the control of St. Johns-wort. See Plate 11 for larval features. Harris 1966.

5 Host and Geographical Distribution

Gall midges are widely distributed among gymnosperms and angiosperms, but much less so on ferns and related plants of Pteridophyta. No evidence exists for broad coevolution of plants and gall midges (Möhn 1961b, Roskam 1985). The gall midges on ferns are not ancient cecidomyiids and there is no evidence that gall midges on conifers are more primitive than those on angiosperms. Most predaceous and mycophagous genera and some of the larger phytophagous genera are cosmopolitan, but many phytophagous Cecidomyiinae show some interesting geographic and host distribution patterns that are taken up separately below.

Cosmopolitan

The two largest genera of phytophagous gall midges in number of species, *Dasineura* with 493 and *Contarinia* Rondani with 320, are globally distributed. They are, however, polyphyletic, catchall genera of which most species cause simple galls, such as leaf rolls and bud swellings, or live freely in flower heads. These genera may eventually be separated into more natural groups than presently. Even so, those smaller groups may still show a worldwide distribution, as does, e.g., *Stenodiplosis*. That genus, known from 15 species associated with grass inflorescences and at one time under the *Contarinia* umbrella, is still cosmopolitan.

Among monophyletic world-ranging phytophagous genera with broad host ranges are *Asphondylia* and *Resseliella*. The 316 species of *Asphondylia* form galls mainly in reproductive plant organs. Interestingly, *Trotteria*, a genus of 21 species, all inquilines and almost exclusively in *Asphondylia* galls, is also cosmopolitan. The 56 species of *Resseliella* live in flower heads, in plant stems, under bark, and a few are responsible for simple leaf galls.

Predaceous genera are generally cosmopolitan. The largest is *Lestodiplosis* with its 186 species that prey on many kinds of insects and mites, even millipedes. Some species in that genus are known to feed on a particular host or host group, others are generalists. Other predaceous cecidomyiid genera are more restricted in their habits but are still cosmopolitan or nearly so. These include: *Feltiella* spp., predators of spider mites; *Endaphis* spp., internal parasitoids of Hemiptera and Heteroptera; and *Diadiplosis* spp., a chiefly pantropical group that preys on Hemiptera, particularly scale insects and whiteflies.

Holarctic

Many Holarctic Region phytophagous genera are restricted to certain plant groups extending across the same range. Some examples are *Rabdophaga* on willows, *Cecidomyia* on pines, *Macrodiplosis* and *Polystepha* on oaks, *Celticecis* on hackberries and *Semudobia* on birches. *Semudobia* provides an excellent illustration of interspecific and host relationships of five species (Roskam 1977, 1979). The only one of those five species that is native to both North America and

Eurasia has the most generalized habits and can live in either seeds or bracts. The remaining four species live only in seeds. Two of these four are restricted to North America and are discontinuous, one western, one eastern, on their particular birch hosts. The remaining two are Eurasian natives that arrived in the Nearctic only in the historical period with their host birches that were transplanted here for their ornamental qualities. In an analysis of external anatomy, Roskam (1985) hypothesized that the most generalized species, *S. skuhravae*, is the sister group to the remaining four and has not changed because of its generalized host and biological needs. The two native North American species could have arisen from a common ancestor that became separated from its European population as the two continents drifted apart in the Eocene. Subsequent cooling of North America and consequent isolation on eastern and western portions of the continent could have resulted in the division of the American Semudobia as well as of their host birches.

Several small Holarctic genera of two species each are known, one eastern Nearctic and one European, e.g., *Piceacecis* on spruce, *Craneiobia* on dogwood and *Sequoiomyia* on two species of the cypress family. Notably, the Palearctic species of *Sequoiomyia* is a Pleistocene fossil, its host *Sequoia* having succumbed to the ice ages in Europe. Its Nearctic cousin is extant in cones of bald cypress.

Two larger genera, *Caryomyia* from hickories and *Taxodiomyia* from bald cypress, are now known only from southeastern North America (Gagné 2008). Both genera were presumably present also in Europe prior to the extinction there of hickories and bald cypress during the Pleistocene (Manchester 1987). Hickories are present also in Southeast Asia, but nothing is known of galls on that host there except for one made by a mite (unpub.).

The reverse situation occurs with galls of beech. European and Asian beeches are exclusive hosts to eight described species in three genera, *Hartigiola*, *Mikiola* and *Phegomyia*, that form complex leaf galls (Sato & Yukawa 2004, 2009, Roskam 2019 and Yukawa et al. 2021). A further 22 kinds of galls caused by unnamed gall midges occur on beech in Japan (Tsuda 1982). Yet American beeches are devoid of gall-making cecidomyiids (Sato & Yukawa 2001). Gall midges of beech possibly once occurred in North America but could have become extinct through a bottleneck effect as the host's range became severely constricted during successive Pleistocene glaciations (Davis 1983).

At least two Holarctic genera appear to be recent natural arrivals in North America. Both are species-rich in the Palearctic but have a bare foothold in the Nearctic. *Mayetiola*, with 29 species in culms of grasses, nearly all from Europe and North Africa, is known in North America from only a few species: the native *Mayetiola ammophila* Gagné (1975c) on Atlantic beach grass in New Jersey; two undescribed species from Alaska; the introduced *Mayetiola destructor* (Say) from Europe; and *Mayetiola phalaris* Barnes, previously known only from Europe and recently discovered in Iowa on the widespread Holarctic ribbon grass, *Phalaris arundinacea*. Whether *M. phalaris* is a recent introduction or a longtime resident is conjectural. The other species-rich Palearctic genus is *Macrolabis*, known from 64 European and western Asian species that are inquilines and gall makers on a wide variety of plants. That genus was unknown in the Nearctic until the discovery of *Macrolabis americana* Dorchin (2006) in galls of *Dasineura folliculi* Felt on goldenrods in Pennsylvania.

The tribe Lasiopterini may illustrate an earlier migration of an Old World group into North America. This tribe includes 20 genera, some species-rich, made up mostly of stem gall makers, the majority specializing on Amaranthaceae (Dorchin et al. 2021, Gagné & Jaschhof 2025). Only two of those genera extend into North America. One is *Hybolasioptera*, known from one North American and one European species, both on rye. The other is *Lasioptera*, a large genus with 99

Old World and 31 North American species. While *Lasioptera* is widely distributed in North America, only *Lasioptera kallstroemia* Felt extends as far south as Central America. Interestingly, many Eurasian species of *Lasioptera* occur on grasses, but no native North American species is known from grasses. Only the genus *Isolasioptera* Möhn, with two species known from El Salvador, is endemic to the Americas.

Endemic New World

In contrast to the Lasiopterini above, the entire tribe Alycaulini is a New World endemic group that ranges along the entire length of the Americas. It is known from 20 genera and 219 species that are mostly stem, petiole and midrib gall makers (Gagné & Jaschhof 2025). A further 86 unnamed species are reported in this book. The genus *Alycaulus*, known from Central and South America, has the most primitive characters for the Alycaulini, so the tribe is possibly originally Neotropical with subsequent inroads into the Nearctic. Of the 22 species of *Meunieriella*, another alycauline genus, only two are known from as far north as the United States.

Presumably endemic Neotropical cecidomyiine genera with possible recent incursions into North America include several genera of Asphondyliini. Some genera of this tribe are relatively species-rich in the Neotropics but represented in southern United States by only a few species. Examples are *Bruggmannia* and *Hemiasphondylia* that extend into Florida and southwestern North America. Oddly, of the 23 species of *Bruggmanniella*, another chiefly Neotropical asphondyliine genus, 13 are from Central and South America, two from southwestern United States and eight from southeastern Asia. *Lopesia*, a large genus of 33 species in the Southern Hemisphere, especially South America, exhibits a similar pattern; only one species reaches as far north as Florida and one each is known from Africa and Australia.

Several genera of Nearctic gall midges are known only west of the Great Plains. Examples include *Walshomyia* on junipers and cypresses, *Cembrotia* and *Pinyonia* on single-needle pines and *Lonicerae* and *Chiosperma* on honeysuckles. The western North American phytophagous gall midges can still be regarded as poorly known, but the fact that many genera seem to be restricted there is further support for a distinct regional fauna.

Historical Period Introductions

Thirty plant-feeding cecidomyiids are known to have been accidentally or purposely introduced into North America. Hitchhikers include the aforementioned *Mayetiola destructor* with wheat, *Monarthropalpus flavus* (Schrank) that arrived with boxwood shipped as potted shrubs in the Colonial Period and *Ozirhincus millefolii* (Wachtl) on yarrow, possibly from seed contamination. Many more exotic gall midges may occur here on weeds but have gone unnoticed. The gall on ground-ivy made by the European *Dasineura glechomae* (Kieffer) was recognized not so long ago as a new North American record when the late Edvard Sylvén, who knew the gall from Sweden, happened to notice it along the C & O Canal in Potomac, Maryland.

Purposeful introductions into North America for biocontrol purposes include the European *Zeuxidiplosis* giardi (Kieffer) for control of St. Johnswort in California, the European *Spurgia esulae* Gagné for leafy spurge in western USA and Canada and the Australian *Lophodiplosis trifida* Gagné for paperbark in Florida.

6 Plant Galls

Galls as defined here include any predictable and consistent plant manifestation that occurs in response to feeding or other stimulus by foreign organisms. This definition encompasses almost all damage done to plants by gall midges. It includes even simple leaf spots caused by *Acericecis ocellaris* (Osten Sacken) on maple and circular leaf mines of *Monarthropalpus flavus* (Schrank) on boxwood. Some gall midges may not always form a detectable gall: species of *Neolasioptera* that form a stem swelling when many larvae are present may not show any enlargement at all when only a single larva occurs in a stem.

Particular shapes of cecidomyiid galls have evolved many times on unrelated plant groups. For example, spine-shaped galls that occur on grape, hackberry and hickory are each made by a gall midge from a different tribe. Simple leaf spots or blister galls found on leaves of tulip poplar, magnolia, hazel, grape and many others are made by an array of gall midge genera. Conversely, a group of closely related gall midges may be responsible for a wide variety of galls, as, e.g., the 18 galls shown on Plate 28 that are each made by a separate species of *Rhopalomyia*.

Each cecidomyiid gall maker is responsible for a particular kind of gall, unlike some cynipid or phylloxerid gall makers that cause two very different plant deformations in succeeding generations. But a few cases are known of slight variations in cecidomyiid galls made by opposite sexes or distant populations of a species. Galls made by females of the European *Mikiola fagi* (Hartig) are larger, more ovoid and paler than those made by males (Coutin & Riom 1967). Those of the Japanese *Masakimyia pustulae* are thick- or thin-walled in different parts of Japan, a difference that appears to be dependent on the genetic makeup of the gall midge (Sunose 1985).

Comprehensive schemes for naming and classifying galls have been devised (Felt 1940, Küster 1911, Mani 1964, Wells 1921a). Available nomenclature for galls may be helpful in detailed studies of gall morphology but is unnecessary for purposes of this book where a simplified terminology is used. Here, galls are considered either simple or complex, terms equivalent to kataplasma and prosoplasma, respectively, used in some other works. A simple gall is one that does not differ from normal plant tissue except as a swelling or other slight distortion. Simple galls include spots, swellings, folds and invaginations, all the galls shown on Plate 24. A complex gall is the result of tissue that is completely reorganized into a fundamentally different shape from any structure normally found on the host. Examples of complex galls are the leaf galls on Plate 48.

In this book, a few phrases will serve to characterize some of the simple galls. A leaf spot or leaf blister is an ovoid to circular area, with one or more larvae in a concavity on the underside of the leaf or inside the leaf tissue. If one or both sides are convex, the gall is called a blister instead of a spot. If the whole leaf is rolled to form a tube, the gall is a leaf roll; if only the margin of the leaf is rolled, it is a marginal leaf roll. A vein fold or leaf fold is an inpocketing of the leaf blade, along a vein or between veins, respectively, which does not affect the whole leaf. Two terms occasionally used here for galls are monothalamous and polythalamous. Monothalamous refers to galls with a single larval chamber that contains one or more larvae and polythalamous, to galls with several discrete chambers, each with a single larva.

Development

Cecidomyiid galls are formed as a reaction to larval salivary secretions on rapidly growing meristematic tissue of host plants. For more information on this subject, see Rohfritsch (1987, 1992), Rohfritsch & Shorthouse (1982) and Bronner (1992). To summarize from those works, most galls are initiated on the external surface of the plant with the host tissue quickly growing around the larva. Plant cells affected by salivary secretions change into cytoplasmically dense cells, in effect, nutritive tissue. The wall of these cells is thinner and cell contents are modified. The mandibles of the larva pierce the cells, whose contents are digested and inbibed by the larva. If a larva is removed from a gall at any time during growth, the gall will stop growing (Rohfritsch & Shorthouse 1982).

Galls are in effect a new organ controlled by the gall maker, and cell proliferation of the gall is always organized. Rohfritsch and Shorthouse (1982) show how gall shape is in large part caused by the feeding pattern of the gall midge, on whether the larva feeds at one spot or moves around the interior. In certain complex galls from which full-grown larvae exit, the eventual exit tunnel remains closed while the gall is growing but spreads open when the full-grown larvae are ready to leave.

Significance

Plants derive no benefit from cecidomyiid galls. The presence of galls on leaves and needles causes earlier than normal defoliation (Sunose & Yukawa 1979, West & Shorthouse 1982, Yukawa & Tsuda 1986). The *Neolasioptera* sp. galling the stem of *Mirabilis linearis* (Nyctaginaceae) in Brazil reduces plant size, fruit abundance and seed number (Fernandes et al. 1993). Besides detrimental effects, galls may cause uneven growth of a plant. The apical bud gall of *Rabdophaga strobiloides* on willow asserts a dominance over lateral buds (Weis 1984). Twigs galled by that species grow to greater girth than ungalled twigs, even when leaves are stripped from the galled twigs (Weis & Kapelinski 1984). Apical galls of *Rhopalomyia solidaginis* (Loew) on goldenrod also cause an increase in stem production but a decrease in rhizome and seed development (Hartnett & Abrahamson 1979).

Galls are generally thought of as providing food and shelter for their inhabitants and protecting them from predators. Price et al. (1987) summarized the many hypotheses that have been put forward to explain the significance of galls. The authors favor those that support enhanced nutrition, create a favorable microenvironment and possibly lend some protection from parasites.

Organisms That Form Galls

Most galls are made by gall midges, but they are caused also by other organisms not treated here. With a little practice, one can easily differentiate cecidomyiid galls from those made by other groups (Plate 23). It is important to open more than one gall when trying to determine the gall maker because some may superficially appear to be made by a parasitoid hymenopteran that has completely obliterated the true gall maker. For an excellent illustrated general guide to known galls made by various orders in western United States, Russo 2021 is a must-have reference. Following are notes to help identify galls made by other insect groups and mites.

Cecidomyiidae

Simple cecidomyiid galls will reveal one to several, legless, minute-headed larvae (Plate 23 (1)). Full-grown larvae will usually have a characteristic spatula (Plate 1) although that structure is absent in a few genera. Larvae produce no noticeable waste products. The inside surface of the gall is smooth, except for most galls caused by *Asphondylia*, *Lasioptera* and *Neolasioptera* and relatives that are most often lined with the white mycelium of a symbiotic fungus.

Agromyzidae (Diptera)

This large family is responsible mainly for flat mines that meander through a leaf, although several agromyzids form twig swellings or bud galls (Plate 25 (4)). The maggots always leave behind them a trail of frass, distinguishing their galls from the few mines caused by gall midges. See Eiseman (2025b) for further information on agromyzid galls.

Tephritidae (Diptera)

Tephritids make galls chiefly on western North American asteraceous plants. A common eastern American gall on goldenrod is made by *Eurosta solidaginis* (Plate 23 (6)). Larvae are legless, as are gall midge larvae, but are much larger and more robust, have no external head capsule and only two pairs of spiracles, an anterior pair and a more conspicuous hind pair (Plate 23 (6)).

Hymenoptera

The most commonly encountered gall-forming hymenopterans belong to the Cynipidae, or oak gall wasps. These are found mainly on oak, rose and blackberry, but a growing body of work on cynipids on herbaceous plants is revealing a remarkable level of species diversity. Cynipids form complex galls on oaks, very unlike the simple leaf blisters, folds and rolls made by most gall midges on those trees. Many more gall-associated wasps (gall makers, inquilines and parasitoids) occur in the Chalcidoidea, including in such families as Eurytomidae, Pteromalidae and Eulophidae. It should be noted that the classification of this superfamily has recently changed dramatically. The sawfly family Tenthredinidae also has a few gall makers on willow and poplar. Larvae of all these families differ from those of gall midges in having a conspicuous pair of opposable mandibles on the head capsule (Plate 23 (4)). This figure shows a many-chambered gall formed by a pteromalid, *Hemadas nubilipennis* (Ashmead). Beyond specialist herbivores, a plethora of inquiline, parasitoid, and hyper-parasitoid wasps can also live in hymenopteran galls, all utilizing the galls' resources for their own.

Weld's (1957, 1959 and 1960) self-published manuals on North American cynipids, the first to link host plant, gall type, gall location, and species, are invaluable resources to this day. Felt (1940, 1965) may be helpful for identifying some eastern North American galls made by Hymenoptera. Two papers by Smith (1968, 1970) treat gall making Tenthredinidae. Russo (2021) is a

comprehensive guide to western North American cynipid galls. Marshall (2023) is a guide to Hymenoptera in general.

Eriophyidae (Acarina)

Eriophyid mites form diverse galls on a great variety of plants. Their galls tend to be made of greatly convoluted tissue or consist of simple, globular, sometimes pointed outpocketings of leaves (Plate 23 (3)). The inner surface of a gall may be covered with fine hair. Mites are gregarious, seldom longer than 1 mm and have eight legs. The best reference for North American eriophyid mite galls is Keifer et al. (1982).

Other Arthropod Gall Makers

Galls not caused by Diptera or legless Hymenoptera contain frass or waxy exudate. Most of the organisms that make these galls have legs; if not, as in some weevils (Coleoptera), they have prominent, pigmented head capsules. Several kinds of Hemiptera make galls: Adelgidae form conelike galls on twigs of spruce; Pemphigidae, leaf galls on poplar; Psyllidae, leaf galls on hackberry (Plate 47 (1j)); and Phylloxeridae, leaf galls on hickory (Plate 23 (5)), grape and sour gum (Plate 57 (5)). A few Lepidoptera and Coleoptera form stem and leaf galls (Plate 23 (2)) or mines on various plants. Felt (1940, 1965) can still be helpful in identifying many of these galls. Johnson and Lyon (1989) provides more recent references but does not have complete coverage of galls. Again, see Russo (2021) for a general guide to the known western United States gall fauna and Eiseman (2025b) for leaf miners.

7 Collecting, Rearing and Preparing Gall Midges

Gall midges can be caught in great numbers in flight and are sometimes the most numerous insects in passive flight traps. Plant-feeding cecidomyiids caught this way are of restricted value for the study of plant feeders. Sexes of flight-caught species are difficult to associate with confidence. Even when they can be correctly associated, trapped adults lack the context leant by knowledge of their hosts, biology and immature stages. Slide mounting, a requirement for identifying gall midges, is a time-consuming activity better spent on reared samples. Immature stages and adults of both sexes of phytophagous and predaceous gall midges are crucial for descriptive work.

Collecting Galls

Galls should be picked when larvae are fully grown, when most will show a spatula (Plate 1). If larvae inside the galls are barely visible and have no spatula, they are probably in an early instar and will not reach maturity if disturbed. Most galls are best gathered in clear plastic bags, but paper bags are suitable when condensation on the inside of the plastic could be a problem. This is especially true when the galls cannot be processed until the next day. Collection data, written in pencil, should be placed in the bag. Larvae in simple galls may begin to emerge from galls shortly after galls have been placed in a plastic bag.

At home or in the laboratory, a few galls can be cut open promptly to view the contents. A sample of larvae should be placed in a vial of 95% alcohol and labeled, a few of them destined for slide-mounting, some for possible future molecular analysis. The remaining galls should be saved to rear adults.

Gall samples should be photographed and can be preserved for later reference. Hard galls on stems, most bud galls and most complex galls on leaves need no special treatment and can be kept dry. Any larvae inside the gall tissue will desiccate in place and can be left there until needed for future study. Flat galls such as leaf folds or blisters on leaves can be dried between pages of books or in a plant press to avoid distortion from drying. The more succulent galls prone to shriveling can be kept in alcohol.

Rearing Adults

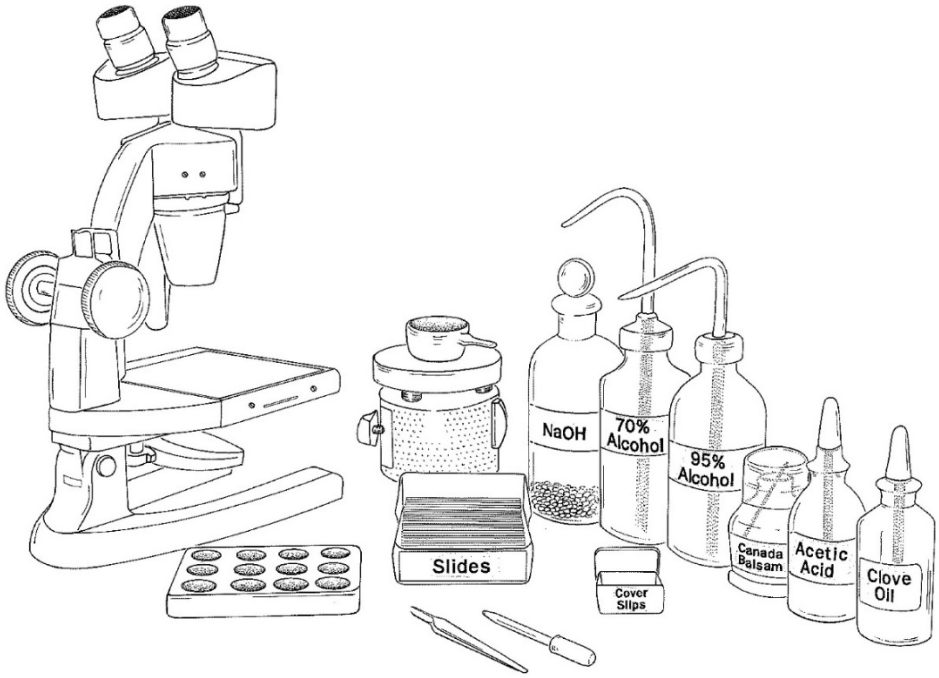
Loose larvae or galls can be placed in pots of approximately 7 cm in each dimension and filled with dampened peat moss. Due to its acidic nature the peat moss prevents most fungal growth but should be microwaved before use to kill any live organisms. Each pot with larvae or galls is then inserted in a clear, gallon-size plastic bag, its open end rolled and knotted closed and kept at room temperature out of direct sunlight. Adults of gall midges with several generations per year may appear within 2-3 weeks, except for the last generation. Those with a single generation per year will require more attention because the larvae require a period of diapause. Stem galls can be

bundled together and their ends inserted in peat moss. When cold weather arrives and adults have not yet appeared, pots can be taken out of the bags, watered and placed in a refrigerator. Care should be taken not to allow the pots to become dry while in the refrigerator. Alternatively, the pots can be covered in fine mesh fixed with a rubber band and placed outside in the garden under a cover of light mulch to allow the larvae to overwinter under more natural conditions (Elsayed et al. 2025). At the end of February, the pots are placed in new individual plastic bags, their ends rolled and knotted, then kept at room temperature. In due course adults of gall midges and hymenopterous parasitoids will emerge from the peat moss or the galls. The plastic bags should be checked daily for adult emergence. Adults can be removed from the bags by catching them with a wet artist's brush and transferring them to a vial of 70% alcohol. If possible, some should be caught and kept dry to preserve color and any patterned scale covering.

A collection of one kind of gall or flower head will sometimes contain more than one species of cecidomyiid. This can usually be determined by initially examining the larvae closely, but inquilines sometimes occur in small numbers and can be missed. Even when larvae leave a host readily, it is wise to inspect closely remaining host plant tissue. For example, *Contarinia* and *Dasineura* larvae in flower heads of, e.g., *Baccharis* will readily leave the plant when full-grown, but *Neolasioptera* larvae in the same heads will remain embedded in the plant tissue.

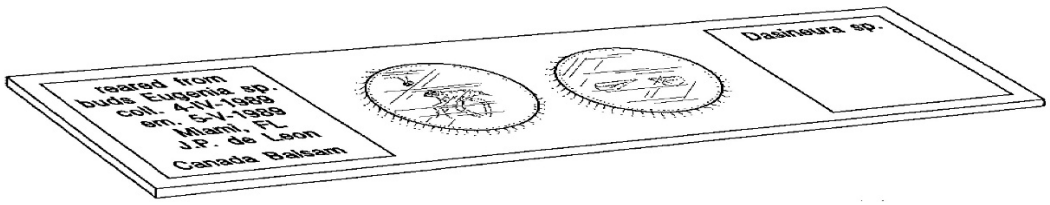
Preparing Specimens for Study

With experience, one can identify some larvae and adults to generic level with a dissecting microscope, but closer inspection will require mounting specimens on slides for study under a compound microscope, preferably one with phase contrast. If a slide is needed, it is best to make a good-quality, permanent one.



Materials and chemicals for making slide mounts.

To dissolve the muscles of a larva or pupa, first prick it once or twice with a fine insect pin. Place the specimen(s) in a small crucible with a solution of sodium hydroxide made of 1 or 2 pellets of NaOH or KOH in about 10 ml of water. The solution can either be heated on a hot plate or a quick result or left overnight at room temperature. If a hot plate is used, allow the solution to boil gently for a minute or so. When the specimen is cleared (all the muscles dissolved), transfer it with an eye dropper to a porcelain spot plate. With fine forceps, transfer the specimen to a drop of acetic acid for a minute to neutralize the sodium hydroxide and then transfer it successively to 70% ethanol, 100% ethanol and finally clove oil for about five minutes in each liquid. Apply a drop of Canada balsam to the slide by means of a glass rod, transfer the larva or pupa to the drop and, after suitably arranging the specimen with the use of needles, carefully lay a cover slip on it. Pupal exuviae can be mounted without clearing, but they should be stored in alcohol long enough so that no air remains in the leg and antennal sheaths. Some practice is required to apply the Canada balsam just thick enough so that the specimen is not distorted beneath the cover slip and yet not so thick that one cannot use the high-power microscope objectives. An easier, alternate mounting medium is Euparal(R), which is miscible with 70% alcohol. With that medium, two steps can be skipped, the 95% alcohol and the clove oil. The optical properties of Euparal are adequate for most work, but the specimen should still be cleared of muscles. Attach a label to each end of the slide, one label to record the host, other collection data and the mounting medium, the other to record the identification.



Sample Slide mount

Preparation of adults takes extra care. If a specimen is not already in alcohol, place it in 70% alcohol for two minutes to wet it. Remove and place the wings directly into a drop of clove oil in the spot plate. Puncture the abdomen with a fine insect pin and place the body in the sodium hydroxide solution. When the specimen is cleared, follow the same process as for the larva. The wings can be mounted under one cover slip, the rest of the body under the other. Once the body is on the cover slip in the drop of Canada balsam, remove the head from the body and arrange it for frontal viewing. If the specimen is a male, disconnect also the terminalia from the body and arrange them dorsoventrally. When several male specimens are available, mount one or two in lateral view with the head and terminalia still attached, so those parts can be studied later in lateral view.

Specimens stored in alcohol deteriorate with time, so mount an adequate sample on slides as soon as possible after collecting or rearing. Because adults of some species are strikingly marked with colored scales that are lost when immersed in liquid, it is desirable to keep some specimens on double mounts or on card points. Some dried adults shrivel slightly, but the scale or color pattern will preserve well on dried specimens. Larvae and pupae can also be mounted on card points for long-term storage. These should be kept the same way and with the same care as for any pinned specimens. More general guidelines for preparing and maintaining a collection are given in Steyskal et al. (1987).

8 Keys to Galls and Plant Damage

The records listed here are to my knowledge complete for gall midges of North America. They are based on the published literature and on the collection of the U.S. National Museum of Natural History (USNM), which includes the historic collection and my own and collaborators' contributions deposited during my tenure at the USNM.

This chapter is arranged first by ferns and allies, then by seed plants, and within those divisions in alphabetical order by host family and genus. Plant names follow Plants of the World Online (POWO) but without author names. Common names for genera are listed in parentheses in the headings. One common name is usually used, but in some cases another one or two in general use are added.

Keys are based primarily on galls or other visual cues, but occasionally on the host, the site of infestation, or characters of associated gall midge larvae. Only the currently valid name for a gall midge is given in the keys. Original species citations, synonyms and other taxonomic information can be found in the catalog by Gagné and Jaschhof (2025). Further information about gall midge genera mentioned in this book can be found in the generic synopsis (Chapter 3).

The paragraph following the name of the species responsible for the gall summarizes what is known of the gall midge and its work. Host(s) and distribution are given for each cecidomyiid, followed by pertinent references. Some recent BugGuide, iNaturalist and Gallformers.org references are added that contain more photos and information than is presented in these keys.

Some past host records may not be correct, and doubtful ones are given in quotations. One should be aware that a collector could have misidentified a plant or that a generic or species concept has changed since the time of collection. An old record attributed to "*Aster* sp.," for example, would now fit into one of several genera, not including *Aster*.

"North America" for purposes of this book comprises the continent inclusive of Canada, United States and Mexico. Provinces of Canada and states of Mexico and United States are given as ranges of distribution. The range of a species is usually described from north to south and east to west. Washington, D.C., is considered here as part of Maryland. Not all states or provinces are listed if a gall midge is widespread; distribution of a species known from New York, Maryland, North Carolina and Florida is given as New York to Florida. The species will likely be found in states in between and inland from those where it has already been collected. One might expect that gall midges may co-occur with their full hosts' ranges, but this is not a rule (Ehler 1982). Even where particular galls generally occur, one must sometimes cover a lot of ground to find them.

Pencil illustrations of plant parts are mostly shown to actual size. Some details were drawn at 2x or 3x, as noted in the figure legends. Most drawings were made from fresh or preserved examples of galls or damage. When galls were not available, previous illustrations were occasionally redrawn to approximately actual size and attribution for the original drawing was given in the figure legend. Some galls, such as simple stem swellings, were not always illustrated.

FERNS and ALLIES

Gall midges of ferns and allies are not from any particular ancient ancestry but belong to groups found also on flowering plants. The very few cecidomyiids known from ferns and horsetails in North America are keyed below. In Eurasia, the only known gall midges on this group are *Dasineura pteridicola* (Kieffer) and *Dasineura pteridis* (Müller), both from simple leaf rolls (Roskam 2019, Skuhravá and Skuhravý 2021). Complex galls on ferns do exist in the Neotropics. One is a spheroidal stem gall made by *Primadiplosis microgrammae* Maia in Brazil on *Microgramma vacciniifolia* (Polypodiaceae) (Maia & Santos 2011). Several other leaf galls whose makers are still undescribed and presumably belong to new genera are known from Costa Rica (Kenji Nishida, in litt.).

Aspleniaceae

Cystopteris (bladderfern)

Root gall …… cecidomyiid

The gall was not described and any specimens on which this record is based are presumed lost (Felt 1918b, 1940, 1965). Host: *C. fragilis*. Distr.: unspecified.

Onoclea (ostrich fern)

In stunted, curled leaves …… *Clinodiplosis* sp.

Larvae of this species are secondary feeders in galls initiated by *Chirosia betuleti* (Ringdahl) (Diptera: Anthomyiidae). Host: *O. struthiopteris*. Distr.: Nova Scotia. Aderkas & Peterson 1987.

Dennstaedtiaceae

Pteridium (bracken fern)

Marginal leaflet fold …… *Dasineura* sp.

Larvae were collected in late May in Oregon and in June in Michigan and Massachusetts. Larvae pupated in the fold and adults emerged in July. Host: *P. aquilinum*. Distr.: Oregon, Michigan, Massachusetts. Brown & McGavin 1982, Eiseman 2025a.

Equisetaceae

Equisetum (horsetail)

From stems in a rearing jar …… *Lasioptera* sp.

The feeding site of this gall midge was undetermined. It was found flying in a jar that contained horsetails from which sawfly larvae were being reared. Stems were gathered in late June 2020 and the single *Lasioptera* adult emerged in March 2021. Host: *Equisetum arvense*. Distr.: Massachusetts. Eiseman 2025a.

Polypodiaceae

Polystichum (shield fern)

Circular black swelling of midrib, see Image 1 …… cecidomyiid

The gall was found in spring after the larva(e) had dropped out. Host: *P. acrostichoides*. Distr.: Pennsylvania.

SEED PLANTS

Acanthaceae

Avicennia (mangrove)

1a Convex swelling projecting from both leaf surfaces, see Image 2 …… …… *Meunieriella avicenniae* (Cook)

Galls are green at first, then turn brown, are 3-5 mm in diameter, rounded and smooth on the upper surface and warty below. Larvae pupate in the gall and adults emerge through an opening on the lower side of the leaf. Host: *A. germinans*. Distr.: Florida, Belize, Cuba, Guadeloupe, Saint Martin. Gagné and Etienne 1996.

1b Aborted flower bud …… … *Asphondylia* sp.

Adults were reared from flower buds. Host: *A. germinans*. Distr.: Florida.

Achatocarpaceae

Phaulothamnus (phaulothamnus, snake eyes)

1a In swollen twig …… … *Neolasioptera* sp.

Swellings are smooth and variable in size but can attain 1 cm in width. They are the same

color as the twig and smooth to ridged and gnarly in texture. Early instars live in ovoid chambers filled with a clear gelatinous substance; older larvae are found in more elongate tunnels apparently lined with fungus. Host: *P. spinescens*. Distr.: Texas.

1b In soft, red, spheroid gall attached to stem …… cecidomyiid

Galls are internodal, sometimes arise even from stem galls of the *Neolasioptera*. They are 2-4 mm in diameter, dark red on the outer surface, green inside, with one or two chambers, each with a single larva. Host: *P. spinescens*. Distr.: Texas.

Amaranthaceae

Amaranthus (amaranth)

1a Enlarged, aborted fruit …… *Asphondylia amaranthi* Felt

Aborted fruit are sometimes only slightly swollen. Pupation occurs inside the gall and the adult emerges a short time afterwards. The gall midge is evidently bivoltine and presumably exploits another tissue when flowers and fruit of its host are unavailable. Hosts: *A. blitoides*, *A. spinosus*. Distr.: Florida, Texas and Tamaulipas. Painter 1935.

1b Swollen stem …… *Neolasioptera palmeri* (Felt)

The original report of this damage (Cockerell 1902) indicated that the swelling was inconspicuous. Only the larva is known. Host: *A. palmeri*. Distr.: New Mexico.

Atriplex (saltbush)

1a Simple stem swellings …… 2
1b Bud, fruit, or leaf gall, or detachable outgrowths of stem …… 4
2a Swelling succulent, covered with short pile, Plate 25 (2a), Plate 26 ……
…… *Asphondylia atriplicis* (Townsend)

Galls are white, green or red and monothalamous or polythalamous, often occurring in tandem, occasionally in a series as long as 10 cm. All stages of the gall maker can be found in all seasons. Host: *A. canescens*. Distr.: California to Texas. Hawkins et al. 1986, Russo 2021.

2b Swellings woody, not covered with gray pile …… 3
3a Swelling tapered or cylindrical, rugose, Plate 25 (1a, b) ……
…… *Neolasioptera willistoni* (Cockerell) and *Lasioptera tibialis* Felt

N. willistoni. Galls are either terminal, hard, ridged and situated at tips of fruit-bearing branches (Plate 25 (1b)), or smooth, softer and on vegetative stems (Plate 25 (1a)). Usually only one larva occupies a gall. Adults can be reared almost any time of the year, so the species

is apparently multivoltine. Pupation takes place in the galls. Hosts: *A. canescens*, *A. polycarpa*, *A. lentiformis*. Distr.: New Mexico to California, Texas. Gagné and Hawkins 1983, Russo 2021.

L. tibialis. This species was reared only once from an apparent *N. willistoni* gall on *A. canescens* in California. It has been reared also from *Keckiella* (Scrophulariaceae) (q.v.), so is presumably an inquiline in these galls. Distr.: California. Gagné and Hawkins 1983.

3b Swelling spheroidal, fissured ..... *Asphondylia nodula* Gagné

Galls appear as wartlike eruptions of the stem, often occur in clusters and are about 4-10 mm in diameter. They can be found in late winter and early spring, are restricted in distribution but may be locally abundant. Hosts: *A. polycarpa*, *A. hymenelytra*. Distr.: California. Hawkins et al. 1986, Russo 2021.

4a Leaf or petiole blister or tiny, nipple-shaped bud gall, Plate 25 (2b) .....
..... *Asphondylia atriplicicola* (Cockerell)

Galls are monothalamous and about 3 mm in diameter. Several may occur on a leaf and cause distortion. The leaf and urn-shaped, nippled gall may be expressions of alternate generations. All stages of the gall maker can be found the year round. Host: *A. canescens,* possibly *A. hymenelytra*. Distr.: New Mexico and California. Hawkins et al. 1986, Russo 2021, Eiseman 2025a.

4b Bud, fruit, or detachable stem gall 5
5a Spheroidal, detachable stem gall, Plate 25 (2c) ..... *Asphondylia caudicis* Gagné

Galls are spherical, green, with very short pile, usually monothalamous and 4-6 mm in diameter. Host: *A. canescens*. Distr.: New Mexico and California. Hawkins et al. 1986, Russo 2021.

5b Axillary bud or fruit gall 6
6a Foreshortened stem covered with leaf clusters ..... *Asphondylia foliata* Gagné

Beneath the leaf clusters the gall is clublike, 2-4 mm long and monothalamous. The smooth galls occur in spring at the tips of axillary buds of foreshortened stems. Host: *A. polycarpa*. Distr.: California. Hawkins et al. 1986.

6b Woolly, spheroidal galls 7
7a On *A. californica*, *A. confertifolia*, *A. polycarpa* and *A. spinifera*, Plate 25 (5) .....
..... *Asphondylia floccosa* Gagné

Masses of galls are 5-30 cm long and up to 1.5 cm in diameter. They occur at the apices of plants in the summer and farther down on the plant in winter. They are monothalamous or polythalamous, white, sometimes pink basally. Hosts: *A. californica*, *A. confertifolia*, *A. polycarpa* and *A. spinifera*. Distr.: California. Hawkins et al. 1986, Russo 2021.

7b On *A. hymenelytra* and *A canescens* …… 8
8a On *A. hymenelytra* …… *Asphondylia* sp.

Galls are bristly, pink to red in autumn and about 1 cm in diameter. They continue to grow to as large as 2.5 cm in spring, by which time they have faded to off-white. Adults emerge in late summer to autumn. Host: *A. hymenelytra*. Distr.: California. Russo 2021.

8b On *A. canescens* …… 9
9a Densely woolly, spherical gall, Plate 25 (3a) …… *Asphondylia neomexicana* (Cockerell)

Galls are monothalamous, white, about 1 cm in diameter, including the trichome covering, and occur in summer and autumn on buds, flowers, or fruit. Host: *A. canescens*. Distr.: New Mexico and California. Hawkins et al. 1986.

9b Short-pilose, oval or spherical gall, Plate 25 (3b) …… *Asphondylia gemmae* Gagné

Galls are monothalamous, ovoid, about 3 mm in diameter and occur in summer and autumn on buds, flowers, or fruit. Host: *A. canescens*. Distr.: California. Hawkins et al. 1986.

Beta (beet)

Larva in seed …… *Asphondylia websteri* Felt

A series of adults and pupae in the USNM that were reared from sugar beet fits this oligophagous southwestern North American species. The series was reared in1940 from seed at Salt River Valley, Arizona. No further details accompany the specimens. Host: *B. vulgaris*. Distr.: Arizona. Hosts, distribution and references as for *A. websteri*, q.v., *Parkinsonia*.

Chenopodium (lamb's quarters)

Swollen floral bud …… *Asphondylia* sp.

Host: *C. album*. Distr.: Texas.

Dysphania (epizote, Mexican tea)

Stem swelling …… *Lasioptera* sp.

This gall, known only from a record in Felt (1940, 1965), is reportedly 1-2 cm long. Host: *D. ambrosioides*. Distr.: unspecified.

Krascheninikovia (winterfat)

1a Irregular bud swelling …… cecidomyiid

This damage is known only from a record in Felt (1940, 1965). Host: *Krascheninikovia* sp. (as *Eurotia*). Distr.: western United States.

1b Tapered stem swelling …… ?*Neolasioptera* sp.

The swelling is 15 mm long and 5 mm at its widest diameter. Adults have not been reared. Host: *Krascheninikovia lanata*. Distr.: California.

Suaeda (seepweed)

Globular, leafy, black bud gall …… *Asphondylia dondiae* Felt

The gall is approximately 5 mm in diameter. The one known specimen of the gall midge was reared in April. Host: *S. calceoliformis*. Distr.: California.

Amaryllidaceae

Allium (onion)

Aborted seed pod …… cecidomyiid

The damage was reported without further details by Maze (1949). Host: *A. canadense*. Distr.: Pennsylvania.

Anacardiaceae

Mangifera (mango)

The two species below are native to India and immigrants to the Neotropics. They have not yet been recorded from North America.

1a Conical flower gall …… *Gephyraulus mangiferae* (Felt)

Infested flowers are aborted while young and develop into ovate, apically tapered galls. Larvae are fully developed in little more than a week and pupate in the galls or on the ground. Host: *M. indica*. Distr.: Guadeloupe (French West Indies); Hawaii and India. Gagné & Etienne 2006.

1b Irregularly spheroid, succulent blisters, often coalesced in masses, on flowers and leaves …… …… *Procontarinia mangiferae* (Felt)

Reported from the Neotropics in the early 1900s, this species has not been reported there since. It is an important pest of mango in India and other parts of Asia. Host: *M. indica*. Distr.: Brazil (Bahia) and St. Vincent, West Indies; India. Prasad 1971, Tokuda & Uechi

2021.

Metopium (Florida poison tree)

In swollen fruit …… *Asphondylia* sp.

Adults emerged from fruit in late March. Nothing further is known of this species. Host: *M. toxiferum*. Distr.: Florida.

Rhus (sumac)

1a Leaf blister …… *Dasineura* sp.

Blisters are sometimes so numerous as to distort young leaves. Host: *R. trilobata*. Distr.: New Mexico, Arizona.

1b Bud galls …… 2
2a Swollen, aborted flower bud, Plate 27 (1) … *Asphondylia integrifoliae* Felt

Infested flower buds are about twice the normal diameter. One larva occurs per bud and pupates in situ. Adults emerge from the current year's flowers, so another generation presumably occurs on a different part of the plant. Hosts: *R. integrifolia*, *R. trilobata*. Distr.: Utah and California. Felt 1916b.

2b Swollen terminal bud …… *Schizomyia* sp.

Galls are ca 1.5 cm long and wide, smooth except for a partial apical rosette of small leaflets. Each gall has one to many chambers, each with a bright orange larva. Full-grown larvae drop to the ground in early August where they presumably overwinter. Host: *R. trilobata*. Distr.: Arizona.

Toxicodendron (poison ivy, poison oak)

1a Leaf galls …… 2
1b Aerial rootlet or subterranean bud galls …… 3
2a Curled leaf margin …… *Contarinia* sp. and *Dasineura* sp.

Margins of newly expanded leaves are tightly curled on the underside. *Contarinia* larvae were taken in New York in June, *Dasineura* larvae in Maryland in early May. Larvae of both are white. At least the *Dasineura* sp. is gregarious. Host: *T. radicans*. Distr.: New York and Maryland.

2b Leaf blister …… cecidomyiid

Galls were listed only as large and small blisters by Maze (1949). Distr.: Pennsylvania.

3a Tuberlike swelling on aerial rootlet, Plate 27 (2) …… *Rhizocecis rhois* (Coquillett)

Each swelling usually contains one larva; occasionally two larvae occur but in separate chambers. Larvae overwinter in the galls from which adults emerge in spring. Host: *T. radicans*. Distr.: New York to Georgia. Gagné 2013.

3b Mossy, subterranean bud gall …… cecidomyiid

This gall was further described only as 1 or 2 inches in diameter (Felt 1940, 1965). Host: *T. radicans*. Distr.: unspecified.

Apiaceae

Angelica (angelica)

Tapered stem swelling …… *Neolasioptera angelicae* (Beutenmüller)

Swellings are 4-5 cm long. Host: *A. venenosa*. Distr.: New York, New Jersey.

Sanicula (sanicle, black snakeroot)

Blackened area or swelling along stem or petiole …… *Neolasioptera* sp.

A black patch along the stem, indicating the presence of a symbiotic fungus, may be all that flags the presence of the larvae if no swelling is apparent. Felt (1940, 1965) identified as "*Asteromyia"* the larvae from a minute, globose stem and leaf enlargement, its collection locality unspecified. His specimens are lost, but the species may have been the same as this *Neolasioptera* collected subsequently. As sometimes also happens with galls of other hosts, e.g., ragweed, the presence of a swelling depends on the number of larvae in the gall. Host: *Sanicula* sp. Distr.: Iowa. See on BugGuide.

Zizia (golden Alexander)

1a Tapered stem swelling …… *Lasioptera ziziae* Felt

Swellings are reportedly about 4 cm long. Larvae overwinter in the stems and adults emerge in spring. Host: *Z. aurea*. Distr.: Illinois.

1b Swollen fruit, see Image 3 …… *Asphondylia* sp.

Aborted fruit are enlarged to greater than twice normal size and curved. Adults emerged in late August. Host: *Z. aurea*. Distr.: Illinois.

Apocynaceae

Adenium (desert rose)

In flower bud …… *Contarinia* sp.

Larvae cause bud decline in this non-native plant. The adult stage of this species is unknown. Host: *A. obesum*. Distr.: Florida.

Apocynum (dogbane)

1a Oval, discolored stem depression …… *Neolasioptera apocyni* (Felt)

Larvae live in individual chambers just below the stem surface. An adult was reared from stems in August, so this species presumably has more than one generation per year. Host: *A. androsaemifolium*. Distr.: New Jersey. Weiss and West 1921.

1b Enlarged flower bud or deformed seed pod …… 2
2a Enlarged flower bud …… *Clinodiplosis apocyni* (Felt) and *Contarinia* sp.

Felt (1918a, 1921) attributed the damage to *Clinodiplosis apocyni* (Felt), but a larva of *Contarinia* sp. collected simultaneously from the buds is nprobably the responsible agent. Host: *A. androsaemifolium*. Distr.: New York.

2b "Pocket gall" on seed pod …… cecidomyiid

The gall was not described further (Maze 1949). Host: *A. androsaemifolium*. Distr.: Pennsylvania.

Asclepias (milkweed)

1a In flower buds that remain unopened …… *Prodiplosis floricola* (Felt)

Larvae are white, becoming yellow and live in the interstices of the flowers, such as stigmatic slits and hoods. They drop to the soil when full-grown. No swelling is apparent. Larvae collected in July emerged as adults the following spring. This is a generalist species with wide host and geographic ranges. It is found elsewhere in eastern North America on *Clematis* sp. (Ranunculaceae) and *Spiraea alba* (Rosaceae), and in Brazil on *Caryocar brasiliense* (Caryocaraceae) and *Citrus* (Rutaceae). Hosts: *A. incarnata*, *A. syriaca*. Distr.: Widespread eastern USA and Brazil. See on iNaturalist,

1b Leaf deformations or node swelling …… 2
2a Rolled leaf or swollen midrib fold …… *Contarinia* sp.

The gall was described separately as a swollen midrib fold and rolled leaves in Felt (1940, 1965). Larvae were taken in July and adults were reared in August, so this species probably has more than one generation per year. *Lestodiplosis* sp., a predator, was also reared from

the damaged leaves. Host: *A. incarnata*. Distr.: New York.

2b Tapered node swelling …… *Neolasioptera asclepiae* Felt

Reportedly, swellings usually contain two larvae, one on each side of the septum of the joint. Larvae overwinter in the gall and adults emerge in spring. Host: *A. incarnata*. Distr.: New York. Felt 1918a.

Echites (loroco)

Flower gall, see Image 4 …… *Schizomyia loroco* Gagné

Females lay eggs in flower buds that produce large succulent galls harboring two to several orange larvae, each enclosed in a separate ovoid chamber. Full-grown larvae drop to the soil to pupate. Several generations occur per year. The plant host is indigenous to Central America. Use of the flowers in Salvadoran cuisine makes loroco an international commodity. Galled flowers are occasionally intercepted at United States ports of entry. Host: *E. panduratus*. Distr.: El Salvador. Gagné & Menjivar 2008.

Funastrum (twinevine)

Larvae in curled leaves …… *Clinodiplosis apocyni* (Felt)

It is possible the adults reared from the leaves were secondary feeders. Host: *F. clausum*. Distr.: Florida.

Aquifoliaceae

(holly)

1a Berries remaining green through winter, Plate 27 (4), see Image 5 … *Asphondylia ilicicola* Foote

Affected berries grow to normal size but remain green through winter, making the trees less desirable for ornamental purposes. Ovules do not develop properly. The usually single larva, occasionally two or three per berry, each in a separate ovule, summers and overwinters as a dormant first instar, accompanied by a small patch of fungal hyphae. In spring, larvae mature quickly and pupate in the berries. The fungus also grows quickly then to cover the inside surface of the chamber. At flowering time, the pupa uses its cephalic and abdominal armament in a rotating motion to cut a cylindrical passage through the flesh of the berry. The pupa becomes lodged halfway out of the berry and the adult emerges. Females lay eggs in the developing fruit while the flower petals are still present. Hosts: *I. decidua*, *I. glabra*, *I. opaca*, *I. vomitoria*. Distr.: Connecticut and Pennsylvania, south to North Carolina. Highland 1964.

1b Enlarged bud or swelling along midvein …… 2

2a Enlarged bud …… *Asphondylia ilicoides* Felt

Infested buds are ovoid, green, 5 mm long, 3 mm in diameter and are reportedly inhabited by several larvae, presumably in individual chambers. Galls were collected in mid-June and adults emerged shortly after. Host: *I. mucronata*. Distr.: New York.

2b Succulent midrib swelling, Plate 27 (3), see Image 6 …… *Contarinia* sp.

Galls may encompass part or all of the leaf. Larvae are gregarious, white while feeding, but yellow when full-grown. Larvae drop to the soil in late April to early May in southern Maryland. A *Clinodiplosis* sp., presumably a secondary inhabitant of the gall, has also been taken from the gall. Host: *I. decidua, I. opaca*, *I. vomitoria*. Distr.: New York to North Carolina.

Araceae

Dieffenbachia (dieffenbachia)

Root swelling …… cecidomyiid

The gall and an unidentified larva inside were intercepted at a United States port of entry on the border with Mexico. Host: *Dieffenbachia* sp. Distr.: Mexico or farther south.

Aristolochiaceae

Aristolochia (Dutchman's pipe)

Leaf blister …… "*Cecidomyia*" *hageni* Aldrich

This species is known only from a description of its damage and larva, the latter being brick red and agile. The circular blisters are reportedly about 4 mm in diameter on leaf blades but larger on petioles. Full-grown larvae escape through a hole in the upper surface of the blister. Host: *A. macrophylla*. Distr.: Massachusetts. Hagen 1881.

Asarum (wild ginger)

In rhizome …… *Neolasioptera* sp.

Larvae were found near the somewhat blackened vegetative end of the rhizomes. Host: *A. canadense*. Distr.: Iowa. See on BugGuide.

Under bud scale at end of rhizome …… *Contarinia* sp.

Larvae were found near the somewhat blackened vegetative end of the rhizomes. Host: *A.*

canadense. Distr.: Iowa. See on BugGuide.

Asparagaceae

A number of American genera in this family have simple leaf spot galls about 8 mm in diameter (as on Plate 80 (1)). These are caused by unidentified cecidomyiid larvae whose adult stage is still unknown. Each spot contains a single larva that leaves the gall when full-grown. Upon departure of the larva, the spot becomes translucent and more noticeable. The gall makers are listed below only as "cecidomyiid," but may belong to *Meunieriella* (see *Smilax* (Smilacaceae) and *Uvularia* (Colchicaceae)). Two other gall midges, *Lauthia crispata* (Felt) and *Camptoneuromyia rubifolia* Felt, have been associated with this leaf spot, but they are both mycophages and presumably secondary inhabitants in the galls.

Agave (agave)

1a Discolored area on leaf ..... *Neolasioptera martelli* Nijveldt

Larvae live and eventually pupate in tunnels under the leaf surface. The affected area dies after adults emerge. Host: *Agave* sp. Distr.: Mexico City.

1b In fruit ..... *Contarinia* sp.

This species is known only from larvae taken from fruit intercepted at El Paso, Texas. Host: *Agave* sp. Distr.: Mexico (state unspecified).

Brodiaea (brodiaea)

Swollen stem ..... *Lasioptera* sp.

Adults emerged in spring from galls collected the previous fall. The gall resembles that on *Triteleia* (q.v.) and other Asparagaceae. Host: *B. californica* and possibly other species. Distr.: California. Russo 2021.

Bloomeria (goldenstar)

Swollen stem below flowers ..... *Lasioptera* sp.

The gall is similar to that on *Triteleia* (q.v.), also *Brodiaea* and *Dipterostemon*. Adults emerge in spring from individual emergence holes along the length of the swollen stem. Host: *B. crocea*. Distr.: California.

Camassia (camas)

Larvae inside ovaries, see Image 7 ..... *Dasineura camassiae* Gagné

Larvae live gregariously within separate ovules, exiting when full-grown through a hole in

the pod, which soon turns necrotic. Larvae diapause in the soil from the time they leave the host in May or June until the following spring. Pupation occurs in spring and adults appear a short time later. Hosts: *Camassia leichtlinii* and *C. quamash*. Distr.: Oregon, Washington. Gagné et al. 2014.

Dipterostemon (snakelily)

Spindle-shaped, swollen stem …… *Lasioptera* sp.

Galls with full-grown, yellow-orange larvae in individual longitudinal tunnels along the swollen stem were found in early August. The adult has not been reared. The gall of this species is similar to those on *Brodiaea* and *Triteleia*. Host: *D. capitatum* (blue dicks, wild hyacinth). Distr.: California. See on BugGuide.

Maianthemum (mayflower)

1a Swollen root …… *Dasineura smilacinae* Bishop and *Dasineura torontoensis* Felt

D. smilacinae. Swellings are about 8 mm long, tapering and monothalamous. Adults were reared in May, presumably from galls held over the winter. This species and *D. torontoensis* are probably synonyms; *D. smilacinae*, the older name, is the one to use until research resolves the problem. Host: *M. canadense*. Distr.: New York.

D. torontoensis. Swellings are reportedly about 8 mm in diameter. Larvae apparently overwinter in the galls. Host: *M. racemosum*. Distr.: Ontario.

1b Circular leaf spot or deformed berry …… 2
2a Leaf spot, Plate 80 (1) …… cecidomyiid

See the note following the Asparagaceae heading. Host: *M. canadense*, *M. racemosum*. Distr.: Massachusetts, Maryland.

2b Deformed berry …… *Asphondylia smilacinae* Felt

Adults emerged from berries in late September to early October. Host: *M. racemosum*. Distr.: Maryland and Virginia.

Polygonatum (Solomon's seal)

Leaf spot …… cecidomyiid

See note under the Asparagaceae heading. Host: *P. biflorum*. Distr.: Massachusetts and Maryland.

Triteleia (triteleia)

Swollen stem below flowers, see Image 8 …… *Lasioptera* sp.

Galls are woody, conspicuous, up to 6 cm long and 15 mm in diameter. The softer, pithy interior harbors numerous orange larvae in separate longitudinal tunnels. Larvae pupate in the gall and adults emerge in spring from individual exit holes along the length of the stem. The gall of this species is similar to those on *Brodiaea* and *Dipterostemon*. Host: *T. laxa*. Distr.: California. Russo 2021.

Yucca (yucca)

Larvae in pod …… *Contarinia* sp. and *Lauthia yuccae* (Felt)

Contarinia sp. Larvae in the USNM collection were repeatedly intercepted with fruit at US ports of entry on the Mexican border. Host: *Yucca* sp. Distr.: Mexico.

L. yuccae. Although reared from pods once, this species is presumably a secondary feeder and not necessarily specific to yucca. A predaceous cecidomyiid, *Lestodiplosis yuccae* Felt, was reared from the same pods as the *Lauthia* species. Host: *Y. glauca*. Distr.: originally unspecified, presumably southwestern United States and Mexico.

Asphodelaceae

Hemerocallis (daylily)

Larvae gregarious inside developing flowers …… *Contarinia quinquenotata* Löw

Gregarious larvae cause buds to become enlarged and distorted and remain closed. Host: *Hemerocallis* sp. Distr.: Immigrant in British Columbia, Washington, Oregon; originally from Europe.

Asteraceae

Achillea (yarrow)

1a Aborted seed …… *Ozirhincus millefolii* (Wachtl)

This species was accidentally introduced into North America, presumably in colonial times, with seed contamination. This multivoltine gall midge can be reared in great numbers from flower heads in summer. Adults are notable for their elongate mouthparts, dorsoventrally flattened heads and long necks. These modifications perhaps allow the gall midge to take liquids from the narrow florets of the host, but this has not been observed. Host: *A. millefolium*. Distr.: coast to coast in North America, wherever the host occurs; native to Europe. Dorchin et al. 2015.

1b Ovoid, white-downy, lateral or terminal bud gall …… *Rhopalomyia* sp.

This 7 mm-long gall from an unspecified locality in North America was referred to as possibly the European *Rhopalomyia millefolii* (Loew) by Felt (1918a, 1940, 1965). The gall and any specimens that might have been reared from it are evidently lost. A photo of a 6 mm-long flower bud gall in Hodges et al. (2006), referred to incorrectly as caused by *Ozirhincus millefolii*, may be made by this species of *Rhopalomyia*. Host: *A. millefolium*. Distr.: unspecified and Florida. Rübsaamen and Hedicke 1926-1939.

Acroptilon (Russian knapweed)

Aborted flower bud …… *Jaapiella ivannikovi* Fedotova

This species was purposely introduced into western North America in 2009 from western Asia for biological control of Russian knapweed. It lays its eggs in apical and lateral buds where a closed rosette of leaves develops and among which the gregarious larvae live. Several generations occur annually. The damage causes seed reduction and stunting of its weedy host. Distr.: Western Asia; Montana to New Mexico and west. Host: *A. repens*. Winston et al. 2014.

Ageratina (snakeroot)

1a Bud galls …… 2
1b Leaf mine or petiole and stem galls …… 4
2a Leafy, hairy gall on terminal and axillary buds with gregarious larvae among modified leaves … …… *Dasineura* sp.

In late summer full-grown larvae were found in cocoons among the leaves that made up the galls. Adults emerged from the cocoons about two weeks later. Host: *A. altissima*. Distr.: Iowa, Ohio. See on BugGuide.

2b Non-leafy, smooth, apical bud gall, the larvae single or in separate chambers …… 3
3a Flower bud gall, Plate 27 (6) …… *Schizomyia eupatoriflorae* (Beutenmüller)

Galls are terminal, globular and succulent and can be found in late summer. The red larvae are active when disturbed and overwinter in the soil. Adults have not yet been described. Host: *A. altissima*. Distr.: Ontario to North Carolina. Beutenmüller 1907a.

3b Apical vegetative bud gall, Plate 27 (5) …… *Asphondylia eupatorii* Felt

The polythalamous green, ovoid or globular, 8-15 mm long and 5-10 mm in diameter, vegetative bud galls appear in late summer. Pupation occurs in the galls and adults emerge in late summer. Eggs are possibly laid on the following year's buds close to the ground. Host: *A. altissima*. Distr.: Pennsylvania and New York to Maryland.

4a Oval, yellowish leaf mine …… cecidomyiid

The mine is reportedly 5-7 mm in diameter. Original examples of the mine and insect are evidently lost. No further report has been made since the first and only mention in Felt 1918a. Host: *A. altissima*. Distr.: unspecified.

4b Leaf vein, petiole or stem swellings 5
5a Leaf vein swelling ..... *Isolasioptera eupatoriensis* Möhn

Adults were reared in August in El Salvador. Host: *A. adenophorum*. Distr.: Morelos south to El Salvador. Möhn 1964.

5b Petiole or stem swelling 6
6a Petiole swelling ..... *Neolasioptera* sp.

This slight petiole swelling may also be made by *Neolasioptera eupatorii* (Felt), but adults have not yet been reared. Host: *A. altissima*. Distr.: Iowa. See on BugGuide.

6b Stem swelling, see Image 9 ..... *Neolasioptera eupatorii* (Felt)

Galls are 15-20 mm long and 5-10 mm in diameter and the same color as the normal stem. One or more yellow to orange larvae live in a tight tunnel along the center of the gall. In northeastern US the full-grown larvae overwinter in the galls and pupate and emerge as adults in spring. In Oklahoma this species apparently has two generations per year. It is distinct from *N. perfoliata* on *Eupatorium*. In Iowa gregarious reddish orange *Resseliella* larvae were found crawling through the pith of stems without noticeable external evidence. See Image 10. Host: *A. altissima*. Distr.: Massachusetts, New York, Maryland, West Virginia, Wisconsin, Iowa, Oklahoma.

Ambrosia (ragweed, cheesebush)

Ambrosia salsola (cheesebush) appeared under *Hymenoclea* in the previous edition. Its gall midge fauna is distinct from that of other *Ambrosia* spp., so that species is treated separately in the key that follows. It is host also to several species of *Asphondylia* whose galls have been too poorly delineated to appear in the key.

1a Galls on *Ambrosia* spp. with the exception of *A. salsola* 2
1b Galls on *Ambrosia salsola* only 6
2a Tapered stem swelling, Plate 27 (10) ..... *Neolasioptera ambrosiae* Felt, *Neolasioptera* sp.

At least two species are present in ragweed stems. *Neolasioptera ambrosiae* is based on a New York series of adults reared from giant ragweed, *A. trifida*, but specimens found on that host in Maryland and West Virginia belong to a different section of *Neolasioptera*. Specimens from common ragweed, *A. artemisiifolia*, in Maryland and elsewhere fit the species from giant ragweed in New York. Larvae of both kinds are orange, single or gregarious and found within individual silken tubes when fully developed in late summer. At least in common ragweed, infestation does not always result in an obvious swelling.

Hosts: *A. artemisiifolia*, *A. trifida*. Distr.: New York to South Carolina, Nebraska to Texas.

2b Leaf swelling or bud galls 2
3a Spherical leaf swelling ..... *Schizomyia* sp.

Swellings are thin-walled and monothalamous, slightly discolored, about 5 mm in diameter. When full-grown, the gregarious, active, orange larvae break out of the gall and drop to the soil to pupate. Adults have not yet been reared. Host: *A. artemisiifolia*. Distr.: Florida.

3b Bud galls 4
4a Tubular gall with concave apices, often in clusters, the larval chambers green, Plate 27 (9) ... . *Contarinia partheniicola* (Cockerell)

Galls are 5-8 mm long, 4-5 mm wide and are found on axillary buds, along stems, at leaf bases, on flowers and along the rachis of the inflorescence. Adults have been reared in spring and fall. Hosts: *A. chamissoniana*, *A. confertiflora*, *A. dumosa*, *A. eriocentra*, *A. psilostachya* and *Parthenium* (q.v.). Distr.: Florida and Texas to California. Gagné 1975a, Russo 2021.

4b Apical swelling or leafy rosette 5
5a Spheroid apical swelling, Plate 27 (7) ..... *Asphondylia ambrosiae* Gagné

Galls are polythalamous and more or less fleshy. Pupation takes place inside the gall in individual chambers lined with a white fungus. In Florida, adults emerged in September, January and February. Hosts: *A. artemisiifolia*, *A. dumosa*, *A. monophylla*, *A. psilostachya*. Distr.: Florida, Texas, Oklahoma and California. Gagné 1975b, Russo 2021.

5b Leafy cluster, the leaves interspersed with hard, thin-shelled chambers, each with one larva, Plate 27 (8) ..... *Rhopalomyia ambrosiae* Gagné and *Rhopalomyia* sp.

More than one species inhabits apical galls that fit this general description on *Ambrosia* spp. The gall maker of *R. ambrosiae* on *A. artemisiifolia* from Florida is a different species from the *Rhopalomyia* sp. on *A. psilostachya* from Texas. I have not seen specimens of *Rhopalomyia* sp. found on *A. eriocentra* in Russo (2021). All *Rhopalomyia* species pupate in their galls. Adults were reared in June from galls in Florida and Texas. Gagné 1975a, Russo 2021.

6a Spindleform stem swellings, with or without long, leafy bracteal rosettes 7
6b Smooth or woolly bud galls 8
7a Gall surface sticky or lacquery, punctuated with leaf primordia ..... *Neolasioptera* sp.

Galls occur on major branches and growth beyond them often dies. This is *Neolasioptera* sp. "A" of Russo 2021. Host: *A. salsola*. Distr.: Arizona and California.

7b Bud gall with long, leafy, bracteal rosettes ..... *Neolasioptera* sp.

More than one species of *Neolasioptera* may be responsible for this gall. Russo (1921: 239-

240) shows two gall forms that differ somewhat in the number and shape of bracts. Hosts: *A. salsola*, *Hymenoclea* sp. Distr.: Arizona and California.

8a Bud galls not woolly 9
8b Bud galls woolly 10
9a Enlarged, sessile bud, Plate 42 (4) ..... *Asphondylia* sp.

Galls occur singly and grow rapidly in February and March to 6 mm long by 2-3 mm in diameter. Adults emerge in mid-March. Host: *A. salsola*. Distr.: California. Russo 2021.

9b Pedicelled gall, with leaves and sometimes branches protruding, Plate 42 (5) … *Asphondylia* sp.

Adults were reared in April. Host: *A. salsola*. Distr.: California.

10a Dense-woolly bud gall, Plate 42 (6) ..... *Asphondylia* sp. and cecidomyiid

Asphondylia sp. Galls are monothalamous, 5-10 mm in diameter and occur apically or axially. Adults emerged from the galls in May. Host: *A. salsola*. Distr.: California.

Cecidomyiid. Felt (1940, 1965) referred to this species as *Rhopalomyia hymenocleae*, but the species was never formally described, so the name is not available. Felt's specimens belong to the supertribe Cecidomyiidi but do not fit any known genus. The elongate ovipositor indicates that this species is a plant-feeder. It is possibly responsible for a different woolly bud gall. Host: *A. salsola*. Distr.: California.

10b Loose-woolly bud gall with protruding, narrow, leafy projections ..... *Asphondylia* sp.

Galls are monothalamous and about 17 mm in diameter. Host: *A. salsola*. Distr.: California. Russo 2021.

Antennaria (pussy-toes)

1a Simple midrib swelling ..... *Neolasioptera* sp.

Galls were collected in mid-December and adults emerged in late January. Host: *Antennaria plantaginifolia*. Distr.: Oklahoma.

1b Complex bud galls 2
2a Ovoid, long-woolly bud gall ..... *Rhopalomyia pilosa* Felt

Galls are white and enclose several hard, thin-walled chambers, each with one larva. The host was only tentatively identified as an *Antennaria*. *Rhopalomyia pilosa* is distinct from *R. antennariae*, a species definitely known from *Antennaria*. Host: ?*Antennaria* sp. Distr.: Northwest Territories.

2b Imbricated, short-woolly leaf bud gall 3

3a Some leaves forming the gall are strongly recurved at the tips, gall many-chambered …… …… *Rhopalomyia antennariae* (Wheeler)

Galls are polythalamous and develop in May. Adult gall midges reportedly emerged from the galls early the following spring. Host: *A. plantaginifolia*. Distr.: Maine to New York, and Wisconsin.

3b Leaves forming the gall are barely recurved at the tip, gall with a single, central chamber, Plate 27 (11) …… *Asphondylia antennariae* (Wheeler)

Galls are reportedly longer than those of *R. antennariae* and each contains a single larva in a hard, central chamber. Although not noted originally, the larval chamber may also be lined with a white fungus, which would be absent in the *Rhopalomyia* galls. The adult emerges in early spring (Wheeler 1889). Host: *A. plantaginifolia*. Distr.: Oklahoma, Wisconsin, New York and Maine.

Anthemis (chamomile)

Larva in flower head …… *Clinodiplosis* sp.

A characteristic *Clinodiplosis* larva in the Felt collection is evidently the basis for the record of "*Cecidomyia* sp." in Felt (1911). This species is not necessarily a primary plant-feeder or restricted to this host. Host: *Anthemis* sp. Distr.: New York.

Arctium (burdock)

Larva in flower head …… cecidomyiid

This record, from Felt (1911), is based on yellowish larvae that are apparently lost. No particular damage to the fruit was reported. Host: *Arctium* sp. Distr.: unspecified.

Artemisia (sagebrush)

Sagebrush galls are almost all formed by *Rhopalomyia* spp. Eggs are laid on the plant surface and hatchlings crawl to their appropriate specific host site where they soon become embedded in the fast-growing meristematic tissue. Larvae lack a spatula or other prominent features. Pupation occurs within the larval chamber. Pupae break through to the exterior with the help of antennal and frontal projections. All except a few species have a single generation per year and overwinter in the perennial tissue where they are situated, but the instar in which they overwinter varies among species. The remaining species, e.g. *R. ampullaria*, are bivoltine because one of the generations lives in ephemeral tissue that lasts only through spring and thus is not a suitable place in which to overwinter. Some species are common, others rare. Three described species of *Rhopalomyia* and one *Asphondylia* reared from *Artemisia* in western United States are not keyed here because their galls were not described in enough detail. These species are *R. coloradella* (Cockerell), *R. erii* (Felt), *R. tridentatae* Rübsaamen and *Asphondylia artemisiae* Felt. In addition, an *Asphondylia* sp. from spongy bud galls was reported on *Artemisia tridentata* in Wyoming (Fronk et al. 1964), but the galls

and specimens cannot be located. No species of *Asphondylia* were found on *Artemisia* during a concentrated three-year collecting effort in Idaho by Robert G. Jones. Jones et al. 1983, Russo 2021.

1a Galls on *Artemisia tridentata* 2
1b Galls on other species of *Artemisia* 27
2a Galls on leaves 3
2b Galls on other plant parts 12
3a Galls globular, soft, spongy 4
3b Galls cylindrical or capsular, hard 6
4a Gall surface bare, Plates 28 (1o), 29 (6) ..... *Rhopalomyia calvipomum* Gagné

Galls appear on persistent leaves, are irregularly lobed and polythalamous to globular and monothalamous, with a diameter of 8-20 mm. Growth begins slowly in autumn, but the galls grow rapidly to their full size in spring. Adults emerge in April and May in Idaho. Host: *A. tridentata*. Distr.: Idaho, Nevada and California. Jones et al. 1983, Russo 2021.

4b Gall surface covered with short or long trichomes 5
5a Gall surface with short trichomes, red to green, Plates 28 (1m, n), 29 (1-5) ..... *Rhopalomyia pomum* Gagné

Galls occur on persistent leaves and are probably the most commonly found on big sagebrush. They are 8-45 mm in diameter and may be irregularly lobed and polythalamous to globular and monothalamous. In Idaho they begin to grow in autumn, with their greatest growth spurt in spring. Adults emerge in May to mid-July, depending on elevation. Host: *A. tridentata*. Distr.: Montana to Washington south to Nebraska and California. Jones et al. 1983, Russo 2021.

5b Gall surface with long white trichomes, surface color not visible, Plates 28 (l), 29 (7-8) ..... *Rhopalomyia hirtipomum* Gagné

Ovoid and monothalamous, several galls may grow close together on the same leaf. Galls are smaller than those of *R. pomum*, with a diameter of 8-15 mm. Growth begins in autumn but galls reach their ultimate size only in spring. Adults emerge in April in Idaho. This gall is probably the one that Felt (1918a) ascribed to *Rhopalomyia navasi* Tavares. The Tavares species makes a somewhat similar gall on terminal or lateral buds on an artemisia in Spain and North Africa, but is unlikely to occur in North America. Host: *A. tridentata*. Distr.: Idaho, Washington and California. Jones et al. 1983, Russo 2021.

6a Gall a flowerlike swelling at end of long, narrow, deformed ephemeral leaf, Plates 28 (1g), 30 (8) ..... *Rhopalomyia culmata* Gagné

The gall consists of a thin 10 mm-long stalk terminating in the shorter leaf tip that surrounds a larval capsule. It occurs only on ephemeral leaves that develop in spring. Adults emerge a short time later. The site of the presumptive overwintering generation of this species is unknown. Host: *A. tridentata*. Distr.: Idaho. Jones et al. 1983.

6b Gall sessile …… 7
7a Gall elongate-cylindrical, with blunt apex, Plates 28 (1i), 30 (1) … *Rhopalomyia tubulus* Gagné

The gall, 3-6 mm long, has a single larval chamber at its base and a thin septum near the apex through which the adult escapes. Adults emerge in spring in Idaho and presumably lay eggs on developing persistent leaves. Host: *A. tridentata*. Distr.: Idaho. Jones et al. 1983.

7b Gall convex at apex …… 8
8a Gall ovoid, widest near midlength, wrinkled … *Rhopalomyia rugosa* Gagné

Galls are 4 mm long by 2-3 mm wide. These are known from a single collection, in spring on persistent leaves. Adults emerged in spring. Host: *A. tridentata*. Distr.: Idaho. Jones et al. 1983.

8b Gall conical or hemispherical …… 9
9a Gall conical, Plates 28 (1f), 30 (6-7) …… *Rhopalomyia ampullaria* Felt

These galls occur mainly on ephemeral leaves, occasionally on stems and flower bracts. The gall midge has two generations per year, the overwintering one developing in flowers, the summer generation on stems and ephemeral leaves. Host: *A. tridentata*. Distr.: Montana and Washington to Utah. Jones et al. 1983, Russo 2021.

9b Gall hemispherical …… 10
10a Gall protruding from both sides of leaf, Plate 30 (5) …… *Rhopalomyia tumidibulla* Gagné

Galls are about 3 mm in diameter and appear on persistent leaves. Adults emerge in spring. Host: *A. tridentata*. Distr.: Idaho, California. Jones et al. 1983, Russo 2021.

10b Gall protruding from one leaf surface only …… 11
11a Gall covered with trichomes similar to those on leaf, Plate 30 (3) … *Rhopalomyia brevibulla* Gagné

Galls are hemispheroid, about 1 mm wide and 1 mm in diameter. Adults emerged in March from galls on persistent leaves. Host: *A. tridentata*. Distr.: Montana to Utah. Jones et al. 1983.

11b Gall covered with trichomes longer than on leaf, Plates 28 (1j), 30 (2) …… *Rhopalomyia hirtibulla* Gagné

Galls are about 1 mm wide and 1 mm in diameter. Adults emerged in March from galls on persistent leaves. Host: *A. tridentata*. Distr.: Idaho, Montana, Utah and California. Jones et al. 1983, Russo 2021.

12a Gall on branch tips or buds …… 13
12b Gall at nodes, on stems or on flowers …… 21
13a Gall woody, a swollen bud with no leaf vestiges …… 14
13b Gall soft, spheroid, with distinct leaf vestiges or a rosette …… 15

14a Gall tubular, open and flared at apex, Plates 28 (1d), 31 (6) … *Rhopalomyia lignitubus* Gagné

Galls are monothalamous, 10-19 mm long, 4-6 mm in diameter at base and develop in spring at the onset of plant growth. A single larval chamber lies inside the base of the gall. Host: *A. tridentata*. Distr.: Idaho. Jones et al. 1983.

14b Gall an irregular aggregate of roughly cylindrical galls, closed and blunt at apex, Plates 28 (1h), 31 (3-4) …… *Rhopalomyia lignea* Gagné

Galls are evidently made up of leaf rudiments, are 8 mm long, 4-6 mm at base across their widest diameter. Host: *A. tridentata*. Distr.: Idaho. Jones et al. 1983.

15a Gall spheroid, soft to leathery, with short leaf vestiges growing from surface of gall, Plates 28 (1c), 32 (7) …… *Rhopalomyia obovata* Gagné

Galls are 5-10 mm diameter with one to several larval chambers inside. Mature or overwintering galls are leathery and yellow-brown. The larva is full-grown in fall; the adult emerges in spring. Host: *A. tridentata*; similar galls occur on *A. arbuscula* and *A. tripartita*. Distr.: Idaho and Washington to Nevada. Jones et al. 1983.

15b Gall spherical and cottony or a rosette of leaves …… 16

16a Gall spherical with long, dense, cottony trichomes and many leaf vestiges, Plates 28 (2), 31 (1-2) …… *Rhopalomyia gossypina* Gagné

Galls develop in late spring and grow 8-15 mm high by 8-16 mm diameter. The cottony mass contains at its base one to several hard capsules growing from the axis of malformed stems. Adults emerge in late summer; this species probably overwinters as young larvae. Similar galls were found on *A. dracunculus* in California. Host: *A. tridentata*. Distr.: Idaho. Jones et al. 1983.

16b Gall a rosette with long and short trichomes …… 17

17a Inner whorl of gall leaves distinctly shorter than outer …… 18

17b Whorls of leaves of similar length but may differ in shape …… 19

18a Larval capsule smooth, tapered at its apex, prominent at center of rosette, Plates 28 (1k), 32 (4-5) …… *Rhopalomyia conica* Gagné

Gall development begins in spring. Larvae are full-grown in fall and adults emerge the following spring. Host: *A. tridentata*; similar galls occur also on *A. arbuscula, A. nova, A. tripartita*. Distr.: Idaho and Washington to Nevada. Jones et al. 1983.

18b Larval capsule rounded, concealed by leaves of rosette, Plates 28 (1a), 32 (1-2) …… …… *Rhopalomyia anthoides* Gagné

This gall resembles that of *R. florella*, but the two gall makers are distinct. The gall is 4-15 mm in diameter and 5-17 mm long. One to 49 capsules can be found in a gall. This species overwinters as larvae and adults emerge in early spring. Host: *A. tridentata*. Distr.: Idaho and

Washington to Utah and Nevada. Jones et al. 1983, Russo 2021.

19a Outer whorls of gall leaves as wide as long, inner whorl with more linear leaves, Plates 28 (1e), 31 (7-8) ..... *Rhopalomyia cramboides* Gagné

The outermost leaves of the whorl are as wide as long, the inner leaves oblong. Adults emerge in spring. Galls develop on new stem growth. Host: *A. tridentata*. Distr.: Idaho. Jones et al. 1983.

19b All whorls of gall leaves similar in shape 20

20a Leaves of rosette widest at base, tapering to a pointed apex, Plate 32 (3) ....*Rhopalomyia florella* Gagné

One generation occurs per year. Adults emerge in early spring. Galls are 12-15 mm diameter, 8-15 mm high. Goeden (2002) shows how the gall of *R. florella* is used and enlarged by *Oxyna palpalis* (Coquillett) (Diptera: Tephritidae). Host: *A. tridentata*. Distr.: Idaho, California. Jones et al. 1983.

20b Leaves of rosette linear, slightly constricted apically, Plate 32 (6) .... *Rhopalomyia mammilla* Gagné

Galls are polythalamous and about 6 mm diameter at their base to 5 mm long. Adults emerge in September. This species evidently overwinters as a young larva. Host: *A. tridentata*. Distr.: Idaho. Jones et al. 1983.

21a Flower gall 22

21b Node or stem gall 25

22a Gall conical but not visible inside unopened flower bud of normal size, Plate 28 (1f) .... *Rhopalomyia ampullaria* Felt

Flower parts inside involucral bracts are modified to form a hard capsule that is densely covered with long, white trichomes. Galls are 3-4 mm long. This gall harbors the overwintering generation. See remarks under entry 9a of this key. Host: *A. tridentata*. Distr.: Montana to Washington south to Utah. Jones et al. 1983, Russo 2021.

22b Node galls or filamentous mass of modified leaves 23

23a Gall ovoid to pyriform, Plates 32 (8), 33 (1) ..... *Rhopalomyia nucula* Gagné

This species overwinters as full-grown larvae; adults appear in spring. The gall is covered with white or gray down, is 3-4 mm in diameter, 3-10 mm long and has 1-11 larval chambers. Host: *A. tridentata*. The same kind of gall occurs on *A. nova*, but the species responsible was not collected. Distr.: Montana to Washington, south to Nevada and Utah. Jones et al. 1983, Russo 2021.

23b Filamentous mass of modified leaves 24

24a Modified leaves with long trichomes, Plates 28 (3), 33 (6) … *Rhopalomyia medusirrasa* Gagné

Galls are white to gray due to the long trichomes covering the modified leaves. The globular mass is 6-16 mm in diameter. This species overwinters as first instars. Larvae complete their development in spring and adults emerge in the same season. Host: *A. tridentata*. Distr.: Idaho, Nevada, California. Jones et al. 1983, Russo 2021.

24b Modified leaves lacking trichomes, Plates 28 (4), 33 (6) …… *Rhopalomyia medusa* Gagné

Galls are green to red, or mixed green and red, 8-30 mm in diameter and begin development in fall but grow mainly in spring. This species overwinters as an early instar and the larva completes its growth in spring, adults appearing soon after. One generation occurs per year. Hosts: *A. arbuscula, A. cana, A. nova, A. tridentata, A. tripartita.* Distr.: Idaho and Montana to Nevada. Jones et al. 1983, Russo 2021.

25a Conical gall on stem, as on Plate 28 (1f) …… *Rhopalomyia ampullaria* Felt

These conical galls occur also on ephemeral leaves and flower bracts. Stems are the overwintering site for these galls. See remarks under entries 9a and 22a of this key. Host: *A. tridentata*. Distr.: Montana and Washington to Utah. Jones et al. 1983, Russo 2021.

25b Stem swelling …… 26

26a Trichomes of swelling no longer or denser than on normal stem, Plate 33 (8) ……
…… *Rhopalomyia tumidicaulis* Gagné

The swollen area, usually on a stunted stem with foreshortened internodes, is 5-23 mm long and contains one to several larval capsules. Adults emerge in late summer. The first sign of gall development is in spring, so the species probably overwinters as first-instars. Host: *A. tridentata*. Distr.: California, Idaho. Jones et al. 1983, Russo 2021.

26b Trichomes of swelling long, forming a dense, white, cottony mat, Plate 33 (7) ……
…… *Rhopalomyia hirticaulis* Gagné

The remarks under entry 26a for *R. tumidicaulis* apply here also. Host: *A. tridentata*. Distr.: Idaho. Jones et al. 1983.

27a Subterranean, ovoid node gall, Plate 34 (4) …… *Rhopalomyia subhumilis* Gagné

Gall midges emerge in late June. One generation occurs per year. Host: *A. ludoviciana*. Distr.: Utah. Ranasinghe 1977, Gagné 1978a.

27b Galls on aerial plant parts …… 28

28a Gall a many-chambered aggregate on stems …… 29

28b Gall single-chambered on leaves or flowers …… 31

29a Gall an assemblage of modified flowers …… *Rhopalomyia alticola* (Cockerell)

Host: *A. campestris*, as "*A. canadensis*." Distr.: Colorado. Felt 1940, 1965, Gagné 1983a.

29b Gall globular or lobed, soft and spongy …… 30
30a Gall on stems of *Artemisia californica* …… *R. floccosa* (Felt)

This is a large, woolly dehiscent gall covered with long trichomes. Groups of galls often coalesce along the stem; individual galls are about 2 mm in diameter. Host: *A. californica*. Gagné 1983a, Russo 2021.

30b Gall on stems of *Artemisia* sp., probably *A. ludoviciana* …… *Rhopalomyia gnaphalodis* Felt

Galls are similar to those formed by *R. hirtipomum*. Specific-level comparison of the two species is not possible because the male and pupa of *R. gnaphalodis* are unknown. Host: originally as *A. gnaphaloides*, now treated as part of *A. ludoviciana*. Distr.: Colorado. Gagné 1983a.

31a Gall a simple blister along midrib, see Image 11 …… *Rhopalomyia* sp.

The gall of this unidentified species was noticed only because pupal exuviae protruded from an inconspicuous blister gall on the leaf midrib. Host: *Artemisia ludoviciana*. Distr.: Oklahoma.

31b Complex galls …… 32a
32a Spherical leaf gall obscured by long, white trichomes, see Image 12 …… *Rhopalomyia* sp.

Host: *A. ludoviciana*. Distr.: Oklahoma.

32b Galls pyriform or conical, not obscured by trichomes …… 33
33a Gall pyriform, Plate 34 (2) …… *Rhopalomyia betheliana* Cockerell

Galls are pyriform, 3-4 mm long, 2 mm in basal diameter, monothalamous, thin-walled and covered with trichomes. The gall occurs also on flowers. Adults emerge in early spring. Host: *A. frigida*. Distr.: Colorado.

33a Gall conical, recumbent …… 34
34a Gall on *A. californica*, Plate 34 (1) …… *Rhopalomyia clinata* Gagné

The gall is monothalamous, thin-walled and protrudes at an angle from the leaf. Adults emerge in spring. Host: *A. californica*. Distr.: California. Gagné 1983a, Russo 2021.

34b Gall on *Artemisia furcata*, Plate 34 (3) …… *Rhopalomyia occidentalis* (Felt)

Adults emerge in spring. Host: *A. heterophylla*, possibly also *A. tridentata*. Distr.: California.

Aster (aster)

Native North American flora previously in *Aster* have now been recombined among several

genera. Most of the gall midges treated under *Aster* in Gagné (1989) are now in *Symphyotrichum*. The remainder will be found under *Chloracantha*, *Doellingeria*, *Eurybia*, *Ionactis* and *Sericocarpus*. Most of these genera still retain "aster" wholly or in part as their common name.

Baccharis (baccharis)

1a In flowers or flower receptacles …… 2
1b In unopened buds or growths on other plant parts …… 3
2a Free in flowers, not gall makers … *Contarinia* spp. and *Dasineura* sp.

Contarinia sp. #1. Larvae are white, found among developing florets and drop to the soil when full-grown. Larvae collected in October on *B. halimifolia* in Maryland emerged as adults the following August at the time its host came into bloom. Hosts: *B. glomeruliflora*, *B. halimifolia*, *B. pteronioides*, *B. salicina*. Distr.: Maryland, Florida, Texas, New Mexico, Durango. Gagné and Boldt 1995.

Contarinia sp. #2. Larvae of this species are red and found among the achenes where they are appressed perpendicular to the pedicels. Host: *B. pteronioides*. Distr.: New Mexico.

Dasineura sp. Larvae are reddish, crawl among developing florets and drop to the soil when full-grown. They can be found at the same time and on the same plant as *Contarinia* sp. #1 above. Hosts: *B. halimifolia*, *B. salicina*. Distr.: Maryland, Florida, New Mexico. Gagné and Boldt 1995.

2b In ovate chamber of swollen flower receptacle, Plate 35 (1-3) …… *Neolasioptera rostrata* Gagné

Larvae grow and eventually pupate in individual chambers in the receptacles. Two generations occur per year in Maryland, possibly more where the season is longer. Overwintering larvae diapause until late the following summer when the hosts come into bloom. Adults have elongated mouthparts, a possible modification for feeding in flowers. Hosts: *B. glomeruliflora*, *B. halimifolia* and *B. neglecta* in North America, *B. myrsinites*, *B. pingraea* and *B. spartioides* in the Neotropics. Distr.: Maryland, Florida, Texas and New Mexico; Dominican Republic and Argentina. Gagné and Boldt 1989, 1995.

3a Complex columnar or spheroid galls on buds, leaves or stems …… 4
3b Simple leaf blister or stem swelling …… 9
4a Spheroid or pyriform bud galls …… 5
4b Complex bud or leaf galls …… 6
5a Globular, spongy, terminal bud gall, Plates 36 (3), 37 (1) …… *Rhopalomyia californica* Felt

Galls are reddish and hairless. This species is multivoltine. Eggs are laid on new buds and the newly hatched larvae crawl between bud scales where the galls begin to form. Pupae ultimately break out of the thin layer at the top of the gall, exit part way, then adults emerge from the pupae. Host: *B. pilularis*; similar galls occur on *B. glutinosa* in Oklahoma, but it is not known whether *R. californica* is responsible for that gall also. Distr.: California, Oregon, possibly Oklahoma; also Australia, where it has been introduced to good effect for the control

of alien baccharis. Ehler 1982, 1987, Gagné and Boldt 1995, Palmer et al. 1993, Rosenheim et al. 2007, Russo 2021.

5b Pyriform, bristly-haired, yellowish gall …… *Rhopalomyia* sp.

Galls, 3-5 mm in diameter, are usually in clusters of two to four. Each gall is topped by a glabrous, conical projection, possibly a modified leaf. Host: *B. sarothroides*. Distr.: California. Russo 2021.

6a Conical apical bud gall of fused leaves surrounded by a rosette, Plate 36 (1) …… …… *Asphondylia bacchariola* Gagné and *Xipholasioptera ensata* Gagné

A. bacchariola. The fused bud scales cover a larval chamber with a single larva. Host: *B. pteronioides* and possibly *B. bigelovii*. Distr.: Texas, Arizona. Gagné and Boldt 1995.

X. ensata. This species was reared once in association with *Asphondylia baccharicola*. Its niche is unknown, but the female has a peculiar sawlike ovipositor. Host: *B. pteronioides*. Distr.: Texas. Gagné and Boldt 1995.

6b Columnar or spheroid leaf galls without subtending rosette …… 7

7a Columnar gall, Plate 36 (4-5) …… *Rhopalomyia sulcata* Gagné

Galls are monothalamous, clustered or solitary, green at first, turning tan, blunt tipped and shallowly furrowed. Hosts: *B. salicina*, *B. neglecta*, *B. pteronioides*, *B. halimifolia*, *B. heterophylla* and *B. sarothroides*. Distr.: Texas to California, Durango and Nuevo Leon. Gagné and Boldt 1995.

7b Ovoid or globular galls …… 8

8a Ovoid gall terminating in a point, on *B. sarothroides* …… *Rhopalomyia* sp.

Galls are about 3 mm long, ovoid, yellow, pink or red, monothalamous, with a granular surface and pointed apically. They are found in spring. Host: *B. sarothroides*. Distribution: California. Russo 2021 (sp. "A").

8b Globular gall, on *B. pilularis* …… *Rhopalomyia* sp.

Galls are monothalamous, 3-4 mm in diameter, ovoid, soft, green to reddish, with a granular surface, usually showing on both sides of the leaf, occasionally encompassing an entire leaf. They are found in spring. Host: *B. sarothroides*. Distribution: California. Russo 2025.

9a Circular leaf blister or superficial epidermal swelling of green stems, at first green, turning black, Plate 37 (3) …… *Asteromyia* spp.

Three undescribed species of *Asteromyia* have been found on *Baccharis* in Texas alone, two from *B. salicina* and one from both *B. pteronioides* and *B. bigelovii*. Hosts: *B. angustifolia*, *B. bigelovii*, *B. halimifolia*, *B. pteronioides* and *B. salicina*. Distr.: Massachusetts, North

Carolina, Texas, Gagné and Boldt 1995.

9b Swollen or sinuous, twisted stems 10
10a Sinuous, twisted stem ..... *Rhopalomyia baccharis* Felt

Larvae live singly in linear chambers in the cambium layer just beneath the bark. Affected areas of the stem become twisted, apparently in response to positioning of larvae along one or alternating sides of the stems. Stems are slightly swollen and longitudinally ridged. A slit-like opening along the stem appears prior to adult emergence, precluding a role for the pupa in preparing an exit. This species has two generations per year. Distr.: California. Host: *B. pilularis*. Russo 2021.

10b Evenly tapered, swollen stem, the stem not twisted 11
11a Woody, brown, evenly tapered swelling, situated at base of plant .....
..... *Neolasioptera baccharicola* Gagné

Adults were reared from galls in spring. Host: *B. halimifolia*. Distr.: Maryland, Virginia. Gagné 1971a.

11b Green, irregularly spheroid or fusiform swelling along length of stem, Plates 36 (2), 37 (2) .....
..... *Neolasioptera lathami* Gagné and *Asphondylia* sp.

N. lathami. This species is at least bivoltine inasmuch as the galls occur on both lower and upper parts of the stem. Galls sometimes produce stunting in young plants. Eggs are laid mostly in stem terminals, but some are placed in leaf axils. Hosts: *B. halimifolia*, *B. neglecta*, *B. sarothroides* and *B. salicina*. Distr.: New York to Florida and Texas and Arizona. Diatloff and Palmer 1987, Gagné and Boldt 1995.

Asphondylia sp. The stem swelling attributed to this undescribed species in Felt (1940, 1965) was reportedly potato-like, 1.2-3.5 mm long and about 1.2 mm wide. Further particulars including the collection locality were unspecified, but the gall of *Neolasioptera lathami* on the upper stem is also sometimes large and spheroidal. I have never found an *Asphondylia* in such galls on *Baccharis*. Host: *B. pilularis*. Distr.: Unspecified.

Bebbia (sweetbush)

Galls on flower head ..... *Asphondylia* sp.

The gall structure was not specified further. Adults were reared from November to January. Host: *B. juncea*. Distr.: California.

Bidens (beggar-ticks)

1a In flower heads 2
1b Stem galls 3
2a larva in modified, aborted floret, Plate 37 (4) ..... *Asphondylia bidens* Johannsen

Adults were reared from November to January. Host: *B. pilosa*. Distr.: Florida. Needham 1946.

2b Larva free, stationary between and parallel to achenes …… cecidomyiid

Orange larvae were found in October. Host: *B. polylepis*. Distr.: West Virginia.

3a Slender, woody, tapered stem swelling …… *Neolasioptera* sp.

Swellings were reportedly about 13 mm long (Felt 1940, 1965). The gall maker is unknown and only tentatively placed in *Neolasioptera*. Host: *Bidens* sp. Distr.: New York.

3b Globular, succulent outgrowth of stem, leaf petioles and main veins, Plate 37 (5), see Image 13 …… *Asphondylia ovata* Plakidas

Galls are monothalamous. Females emerging in September lay eggs of the next generation in meristematic tissue at the base of the plant (Plakidas 2016). *Asphondylia anaceliae* Möhn was described from similar galls on *B. squarrosa* in El Salvador. Hosts: *Bidens frondosa*, *B. mitis, B. polylepis* and *Bidens* sp. Distr.: Illinois, Pennsylvania to Florida.

Borrichia (seaside tansy)

Swollen branch apex, Plate 37 (7) …… *Asphondylia borrichiae* Rossi and Strong

Galls are green, succulent and contain one to several ovoid chambers, each chamber with a single larva and lined with a white fungal mycelium. Adults emerge from March to December in overlapping generations. Host: *B. frutescens*; also *Iva* spp. Distr.: North Carolina, Florida and Mexico (unspecified). Stiling et al. 1992.

Brickellia (false boneset)

In aborted floret …… cecidomyiid

Yellow larvae were found in winter in florets that lacked achenes. Host: *Brickellia eupatorioides*. Distr.: Iowa.

Chloracantha (chloracantha)

Rough, uneven swelling, usually near base of stem …… *Lasioptera asterspinosae* White

Galls occur from ground level to 1 m above the ground and may completely or partially encircle the stem. They are brown, polythalamous and spongy. Larvae overwinter in the galls and adults emerge in spring. Host: *C. spinosa*. Distr.: Texas. White 1950.

Chondrilla (rush skeletonweed)

Blister on leaf or green stems, Plate 37 (8) ..... *Cystiphora schmidti* (Rübsaamen)

This European gall midge was introduced into North America from Europe in 1975 to aid in controlling rush skeletonweed, an immigrant range pest. Leaf blisters are usually purplish. Females insert eggs into a leaf through the stomata with their peculiar ovipositor (DeClerk & Steeves 1988). This species is multivoltine. Host: *C. juncea*. Distr.: Idaho, Oregon and California; Europe and Middle East. Harris 1975, Caresche and Wapshere 1975, Sobhian and Andres 1978.

Chrysanthemum (chrysanthemum)

Conical galls on leaves, stems and buds, Plate 37 (6) ..... *Rhopalomyia chrysanthemi* (Ahlberg)

The Chrysanthemum gall midge. Severe infestations can cause the plants to become deformed with a reduced number of blooms. At one time this multivoltine species was a serious pest of chrysanthemums in the horticultural trade, but it is rarely reported now, probably due to effective control. This species is presumably an immigrant from Asia transported with cultivated chrysanthemums. It may have arrived in North America as early as 1900. Hosts: *Chrysanthemum* spp., including cultivars. Distr.: cosmopolitan, potentially wherever chrysanthemums are grown, although no longer common in North America. Barnes 1948b.

Chrysopsis (goldenaster)

Woolly, leafy bud gall, Plate 41 (6) ..... *Rhopalomyia chrysopsidis* (Loew)

Galls are polythalamous. Adults emerge in late summer, so the species presumably overwinters as first instars in the crown. Host: *C. mariana*. Distr.: New York and Maryland.

Chrysothamnus (rabbitbrush)

Some plant species previously placed under this genus have now been transferred to *Ericameria* (q.v.). This leaves only a few galls here that were tied to species that remain in *Chrysothamnus* or whose host was given only as "*Chrysothamnus* sp." *Rhopalomyia truncula* Foote was reared from “evidently undeveloped terminal buds” of “*Bigelovia* sp.” near Los Angeles, California (Felt 1908), so is not keyed here or under *Ericameria*.

1a Elliptical, discolored blister on leaf or stem, Plate 38 (1) ..... *Asteromyia chrysothamni* Felt

Galls are buff to blue-gray. Larvae are surrounded by a symbiotic fungus that becomes hard and black with age. More than one species could be masked under this species name. Hosts: *C. greenei, C. viscidiflorus*; see also *Ericameria* and *Stenotus*. Distr.: widespread in western North America: Saskatchewan to Texas and west. Gagné 1968a.

1b Bud galls 2

2a Gall covered exteriorly by overlapping leaves, Plate 38 (3) ..... *Asphondylia bigeloviaebrassicoides* (Townsend) and *Asphondylia chrysothamni* Felt

A. bigeloviaebrassicoides This species was described from galls that are now lost, but a gall in the USNM that is illustrated here seems to fit the original description. Similar galls contain an *Asphondylia* pupa in a central chamber. Townsend's description mentioned that the larval chamber was covered with white tomentum, presumably a reference to the fungal associate found in most *Asphondylia* galls. Host: *Chrysothamnus* sp. Distr.: New Mexico.

A. chrysothamni. The gall of this species, which may possibly be synonymous with Townsend's species, was described only as a swollen or enlarged leaf bud, 5-6 mm long, 3 mm wide, the walls composed of short, ovate, aborted, glume-like leaflets without any specialized central chamber. Host: *Chrysothamnus* sp. Distr.: Utah.

2b Gall smooth, ovoid, without leaves incorporated in its surface, Plate 38 (2) ..... *Rhopalomyia bigelovioides* Felt

The gall is reportedly about 1 cm long. Host: *Chrysothamnus* sp. Distr.: California.

Cirsium (thistle)

1a Larva in leaf or stem 2
1b Larva in flower head 3
2a Larva in swollen stem ..... *Lasioptera* sp.

Adults were reared from stems in August. Host: *C. occidentale*. Distr.: California.

2b Larva in inconspicuous leaf midrib blister ..... *Neolasioptera* sp.

Pupal exuviae were found in early August protruding from normal-appearing midribs of leaves collected in late July. Host: *Cirsium* sp. Distr.: Iowa. Eiseman 2025a.

3a Larva free in flower heads ..... *Jaapiella gibsoni* (Felt)

Larvae live gregariously among the florets and affect development of the achenes. Adults were reared both in June from overwintering larvae and in September from flower heads, so the species is at least bivoltine. It is possibly synonymous with *Jaapiella cirsiicola* (Rübsaamen), known from *Cirsium* flowers in Europe where the host originated. Hosts: *C. arvense*, *C. vulgare*, both aliens introduced into North America, presumably in seed contamination from Europe. Distr.: Massachusetts to Ontario, Indiana and British Columbia.

3b Larva in flower heads, presumably inside plant tissue ..... *Neolasioptera* sp.

Adults were reared from flower heads in July but the particular site or damage was unspecified. Host: *C. occidentale*. Distr.: California.

Conoclinium (blue mistflower)

Larva in flower head ..... *Asphondylia* sp.

Adults were reared from unspecified damage found in seed heads in April in Florida. This species may be identical with *Asphondylia corbulae* Möhn found in El Salvador. Host: *C. coelestinum*. Distr.: Florida.

Conyza (horseweed)

Conyza canadensis should fall under *Erigeron* (POWO), but it is kept separate from *Erigeron* here because it has a partially distinctive gall midge fauna.

1a Larva in flower head or bud gall 2
1b Larva in leaf or stem 3
2a Larva free in flower head ..... *Contarinia* sp.

Many larvae were found crawling out of flower heads in October. Host: *C. canadensis*. Distr.: Maryland.

2b Larva in enlarged bud at plant apex, see Image 14 ..... *Asphondylia* sp.

The gall is apical, 12-15 mm long and 6-10 mm in diameter. Galls were found in mid-August when most adults had already emerged. The site occupied by the next generation is unknown but is presumably in the crown. Brandhorst (1977) attributed the gall to *Rhopalomyia erigerontis* Felt, a species on *Erigeron*. The gall of *Asphondylia* in this couplet is lined with a symbiotic fungus, which does not appear in *Rhopalomyia* galls. Host: *C. canadensis*. Distr.: Oklahoma, Nebraska, West Virginia, Maryland.

3a Larva in leaf blister or petiole swelling 4
3b Larva in stem 5
4a Green to purplish, simple leaf blister, Plate 38 (8) ..... *Asteromyia modesta* (Felt)

Blisters are often inconspicuous unless discolored. No fungus appears to be associated with these galls, unlike galls of most other *Asteromyia* spp. This gall midge is multivoltine, each succeeding generation appearing on leaves higher up the stem. Hosts: *C. canadensis* as well as, reportedly, *Erigeron* and *Grindelia*. Distr.: eastern North America, Colorado and Oklahoma. Gagné 1968a.

4b Enlarged, calloused, winter-persistent base of petiole, Plate 38 (9) ..... *Asteromyia* sp.

Galls can easily be seen along most of the stem length in autumn after dried leaves have fallen from the plant. This species is either the overwintering form of *Asteromyia modesta* or a different species. Full-grown larvae are orange and overwinter in the galls. Adults emerge in spring. Host: *C. canadensis*. Distr.: eastern North America and Brazil and Argentina. Gagné 1968a, 1994.

5a Larva in fusiform stem swelling, either rough and usually to one side of stem or smooth and symmetrically tapered, Plate 38 (10) ..... *Neolasioptera eregeroni* (Brodie) and *N. erigerontis* Felt

Two kinds of stem galls occur on this host: one is a large, more or less soft and pithy gall near the base of or midway up the stem; the other is smaller and woody and occurs on branches of the inflorescence. The first kind appears in summer and varies in size, usually many centimeters long and twice the normal diameter of the stem. It is polythalamous and can contain as many as 50 larvae. The other appears in late summer and fall, is monothalamous and usually about 10 mm long by 5 mm in diameter. Adults from at least the large galls emerge from the hosts in both summer and spring. The two galls are formed by distinct species, but the *Neolasioptera* responsible for each of them has not been resolved. Brodie (1894) wrote that some larvae escaped from the galls, a habit not otherwise known for *Neolasioptera*. Host: *C. canadensis*. Distr.: widespread North America, El Salvador. Gagné 1968a, 1994.

5b Larva in pith of apparently normal stem ..... Resseliella sp.

Some infested stems showed black discoloration externally. One to 20 bright orange to red larvae occurred along the pith. Host: *C. canadensis*. Distr.: Maryland.

Coreopsis (tickseed)

Ia Apical meristem gall, see Image 15..... *Contarinia* sp.

Gregarious larvae were found on leafy shoot tips in June. Host: *C. palmata*. Distr.: Iowa. See on BugGuide.

1b Spheroid flower swelling, ... *Asphondylia* sp.

Galls were found on flower heads in late September. Host: *C. palmata, C. tripteris*. Distr.: West Virginia.

Corethrogyne (sandaster)

Flower heads completely bracteate and densely covered with cotton, see Image 16 ..... *Rhopalomyia* sp. and *Asteromyia* sp.

Rhopalomyia sp. This species, presumably new to science, is evidently the cause of the modified flower head. Before beginning to feed, first instars initiate upright conical galls about 2.5 mm long amid a dense, white, cottony that covers the entire inflorescence. Modified flower heads are evident in early summer. Adults emerge in August. Host: *Corethrogyne filaginifolia*. Distr.: California. See on iNaturalist.

Asteromyia sp. Larvae of this new species live in blister galls on both outer and inner bracts

of the modified flower head. Adults emerge in late July and August. Blister galls were not noticed on lower stem leaves after repeated searches. Host: *Corethrogyne filaginifolia*. Distr.: California.

Doellingeria

1a Swollen stem …… *Neolasioptera* sp.

This woody gall was found just below the inflorescence. Host: *D. umbellata*. Distr.: Minnesota.

1b Bud galls …… 2
2a Cauliflower-like bud gall …… *Rhopalomyia* sp.

The dense flower head is made up of many individual galls. Adults emerged from the galls in early September. Host: *Doellingeria ledophylla*. Distr.: Oregon. See on iNaturalist.

2b Artichoke-like bud gall …… *Dasineura* sp.

Larvae of the *Dasineura*, presumably responsible for the gall, were accompanied by those of a *Clinodiplosis* and a *Lestodiplosis*. Host: *Doellingeria umbellata*. Distr.: Maine. Eiseman 2025a.

Echinacea (purple coneflower)

Swollen, aborted floret, see Image 17 …… cecidomyiid

Modified florets on the side of the disc were found in late August. Host: *E. pallida*. Distr.: Missouri.

Elephantopus (elephant's foot)

Spherical, succulent bud swelling …… *Asphondylia* sp.

Galls are green and contain several larval chambers. Adults were reared in August. Host: *Elephantopus carolinianus*. Distr.: Oklahoma. See on BugGuide.

Encelia (brittlebush)

1a Leafy bud gall at leaf axils …… *Asphondylia enceliae* Felt

The gall is globular, white-woolly, about 1 cm long and slightly less in diameter. Adults were reared in February. Host: *E. californica*, *E. farinosa*. Distr.: California. Russo 2021.

1b Conical or spheroidal, thick-walled gall on buds, stems, leaves or flowers ……
…… *Contarinia enceliae* (Felt) and *Rhopalomyia* sp.

C. enceliae. The gall is 6 mm long, 3 mm in diameter, white or gray pubescent and rounded or flared at the apex. Galls are monothalamous but occasionally confluent and may deform the stem. Felt (1916b) reported this as a bud gall. Host: *E. californica*. Distr.: California.

Rhopalomyia sp. According to the description in Russo (2021), this is a similar gall to that of *C. enceliae*, but slightly larger, occurring mostly on leaves but also on flowers. Adults emerged in March. Host: *E. farinosa*. Distr.: California.

Erechtites (burnweed)

1a Irregular stem enlargement, see Image 18 ..... *Neolasioptera* sp.

Swellings are 2-5 cm long and 1-2 cm wide and initially soft, becoming woody. Galls made by the first generation of the season can be found in early to mid-summer on the lower stem, often as an enlargement on one side. At least one and possibly two further generations can be found in swellings farther up the stem and eventually just below the flower heads. Eggs are laid at nodes and the newly hatched larvae find their way into the pithy interior. Host: *E. hieraciifolia*. Distr.: eastern United States.

1b In flower 2
2a Unspecified flowerhead gall ..... *Asphondylia* sp.

The gall of this species was not described further (Felt 1918d). Host: *Erechtites* sp. Distr.: unspecified.

2b Larvae free in flower ..... *Contarinia* sp.

Browning of bracts can be an exterior sign of larval presence. Host: *E. hieraciifolia*. Distr.: Massachusetts. Eiseman 2025a.

Ericameria (goldenbush)

Ericameria now includes some species that were formerly in *Chrysothamnus* and *Stenotus*. See also those genera.

1a Stem or leaf galls 2
1b Bud galls 5
2a Simple blisters or symmetrical stem swellings 3
2b Spheroid jellylike or cottony stem eruptions 4
3a Simple, discolored blister on leaf or along stem, Plate 38 (1) ..... *Asteromyia chrysothamni* Felt

Galls are blue-gray to black, elongate-elliptical, 5-15 mm, usually only weakly convex, becoming hard when mature. Several larvae may live in separate chambers in a single gall. Hosts: *E. albida*, *E. linearifolia*, *E. nauseosa*, *E. parryi*, *Ericameria* sp.; the same species may also occur on *Chrysothamnus* spp. and *Stenotus armerioides*. Distr.: New York,

Alabama and widespread in western North America. Gagné 1968a.

3b Symmetrical, fusiform stem swelling …… *Neolasioptera* sp.

Several larvae live in tunnels in the stem. Host: *E. nauseosa*. Distr.: New Mexico.

4a Swelling jelly-like or resinous, Plate 38 (6) …… *Rhopalomyia glutinosa* Felt

The gall is monothalamous, jellylike in appearance but hard, green to black and 3 mm high by 4 mm wide. Host: *E. nauseosa*. Distr.: Utah, California. Russo 2021.

4b Swelling of same texture as stem, with cottony fibers protruding from apex, Plate 38 (7) …… …… *Rhopalomyia chrysothamni* Felt

Galls are monothalamous and often cylindrical and perpendicular to the stem. Host: *E. nauseosa*. Distr.: Utah, California. Russo 2021.

5a Woolly or smooth bud gall, neither basally nor entirely covered by leafy bracts …… *Rhopalomyia bigeloviae* (Cockerell) in gall of*Aciurina bigeloviae* (Cockerell) (Tephritidae)

Rhopalomyia bigelovii was originally reared in association with large woolly galls of the tephritid fly *Aciurina bigeloviae* (Cockerell) in Colorado. It was subsequently reared from different morphs of galls formed by another tephritid, *Aciurina trixa* Curran (Headrick and Goeden 1997). The morphs of *A. trixa* include large spheroidal, smooth, waxy galls and cottony galls. The *Rhopalomyia* galls appear as nodules at the top of *A. trixa* galls and assume the surface characteristics of the tephritid gall, either a smooth, waxy surface or a cotton-covered surface. Tephritid galls harbor only the spring generation of the *Rhopalomyia*. The site of the overwintering generation is unknown. Headrick and Goeden (1997) found that while the *Rhopalomyia* was dependent in spring on tephritid galls, there was no indication that it affected the development of the tephritid. Host: *E. nauseosa*. Distr.: Western North America. Distr.: California and Colorado.

5b Bud galls made up of or surrounded by leafy bracts …… 6
6a Glutinous, knobby bud gall …… *Rhopalomyia* sp.

Galls are polythalamous, 7-10 mm in diameter and situated on terminal buds, with modified leaves surrounding the base. Each apical knob corresponds to a larval chamber just below the surface. Host: *E. cuneata* var. *spathulata*. Distr.: California. Russo 2021.

6b Closed or open, non-sticky rosette galls …… 7
7a Gall cottony, irregularly globular, with recurved leaf tips emerging from surface, Plate 38 (4) … ……*Rhopalomyia bigeloviaestrobiloides* (Townsend) and *Rhopalomyia utahensis* Felt

R. bigeloviaestrobiloides. This is known only from the original description of the gall, which is similar to that of the following species. The two may be synonymous. Host: *Ericameria* sp. Distr.: New Mexico.

R. utahensis. Galls develop quickly in early spring with the onset of leaf growth. Adults emerge from the galls in April and May. Eggs or first instars enter and remain in diapause until the following spring. One generation occurs per year. Host: *E. nauseosa*. Distr.: Idaho and Utah. Wangberg 1981.

7b Galls not covered with long cottony fibers 8
8a Open rosette with erect or recurved leafy bracts, Plate 38 (15) ... *Rhopalomyia ericameriae* Felt

Galls occur on lateral buds, are about 7 mm long by 5 mm in width, with bracts that are 1-2 mm wide that turn brown and become recurved with age. Adults were reared in April. One generation occurs per year. Host: *E. ericoides*, *E. palmeri*. Distr.: California. Russo 2021.

8b Closed, conical bud gall with closed bracts ..... *Prodiplosis falcata* Gagné

Galls are on terminal buds, 8-10 mm long by 7-8 mm wide, with the bracts 5-8 mm wide at their base. Adults were reared in May, but this species is evidently multivoltine. Hosts: *E. ericoides*; also *Eriogonum* sp. (Polygonaceae). Distr.: California. Russo 2021.

Erigeron (fleabane)

Conyza canadensis (q.v.), now returned to *Erigeron* by most authorities, is treated as a separate genus here because it has a partially distinctive gall midge fauna.

1a In leaves or stems 2
1b In buds or flowers 4
2a Stem showing little or no enlargement ..... *Neolasioptera* sp.

In late summer, full-grown larvae form hard cocoons along the inside periphery of the stem. Host: *E. annuus*. Distr.: Maryland, West Virginia, Iowa.

2b On leaf lamina or petioles 3
3a Oval leaf blister, as on Plate 38 (8) ..... *Asteromyia modesta* (Felt)

Blisters are usually green and inconspicuous but occasionally show some purple or yellow. Galls of this species do not have the associated fungus of most other *Asteromyia* spp. Hosts: *E. strigosus*, *Erigeron* spp. Distr.: widespread North America, Brazil and Argentina. Gagné 1968a, 1994.

3b Enlarged, calloused, winter-persistent base of petiole, as for Plate 38 (9) ..... *Asteromyia* sp.

Galls are readily seen along most of the stem length in autumn after leaves have fallen. This species is either the overwintering form of *Asteromyia modesta* or a different species. Full-grown larvae are orange and overwinter as larvae in the galls. Adults emerge in spring. Host: *E. strigosus, Erigeron* spp.; also *Conyza*, *Grindelia* and *Solidago* (Gagné 1968a). Distr.: widespread North America, Brazil and Argentina. Gagné 1968a, 1994.

4a Distorted head with modified, ampule-like florets …… *Rhopalomyia* sp.

Individual galls atop a flower head are smooth and bear a single larva. Pupation occurs in the gall. Adults emerge in June. Host: *E. annuus*. Distr.: Iowa. See on BugGuide, See on BugGuide.

4b Non-leafy, apical, swollen bud gall, Plate 38 (11) …… *Rhopalomyia erigerontis* Felt

Galls are ovoid, about 1 cm long, have a woolly appearance and are variably enfolded by the narrow stem leaves. Host: *E. foliosus*. Distr.: California.

Eriophyllum (woolly sunflower, golden yarrow)

Abrupt or tapered stem swelling …… *Neolasioptera* sp.

Swellings have the same woolly texture as the stem and are variably shaped, generally 5-7 mm wide by 7-10 mm long. The orange larvae live in separate larval chambers. Host: *E. confertiflorum*. Distr.: California. Russo 2021.

Eupatorium (thoroughwort)

See also *Ageratina*, *Conoclinium* and *Eutrochium* for some species formerly placed in this once much more inclusive genus.

1a Larvae in flowers or florets …… …… *Contarinia perfoliata* Felt and *Neolasioptera eupatoriflorae* (Felt)

C. perfoliata. Gregarious larvae crawl among the developing flowers and may prevent seed set. Host: *E. perfoliatum*. Distr.: New York.

N. eupatoriflorae. The exact feeding site of the larvae of this species is unknown, but adults generally resemble other species of *Neolasioptera* that live in achenes of Asteraceae. Host: *E. hyssopifolium*, *E. perfoliatum*. Distr.: New York and Maryland.

1b Stem or leaf galls …… 2
2a Tapered stem or branchlet swelling, Plate 38 (13) …… *Neolasioptera perfoliata* (Felt)

N. perfoliata. This species has at least two generations per year in Maryland. The first, maturing in August, is found on branchlets before flowers have developed and the second generation is found in September at the bases of flowering branches. Larvae are at first gregarious in the pith. As they grow, the pith structure is reduced to a network of tan, loose strands. No fungus is apparent in galls that I have observed in Maryland. Stem swellings have a color and fuzziness similar to the rest of the stem, are soft at first but later become woody. The branches hosting the first generation continue growth beyond the galls, so the galls do not overtly appear to have a deleterious effect on flowering. Larvae are orange and

active. When full-grown they spin cocoons that line up and coalesce longitudinally, the larval heads directed toward the plant apex. The larvae soon pupate and, when the adults inside are fully developed, the pupae serially advance forward through a single short tunnel at the node above the gall, possibly the same point where their eggs were originally deposited. As each pupa emerges part-way through the hole at the end of the passageway, its abdomen at its broadest dimension is arrested while the adult emerges. The next pupa forces out the previous pupal exuviae and so on. Galls can be found in which several pupae have tightly blocked the exit. Remaining specimens are forced to emerge as adults in the chamber and are trapped inside the gall. Hosts: *E. album*, *E. altissimum*, *E. hyssopifolium*, *E. perfoliatum*, *E. serotinum*; also *Mikania scandens*. Distr.: Massachusetts to Iowa, south to Florida.

2b Hemispherical leaf swelling …… *Ametrodiplosis fulvescens* Plakidas

Swellings are about 5 mm in diameter, thin-walled and show equally on both leaf surfaces. Larvae exit from the underside of the leaf through a hole lined with hairs. Host: *E. perfoliatum*. Distr.: Pennsylvania, Maryland.

Eurybia (aster)

1a In modified floret …… cecidomyiid

The affected floret is modified into a columnar structure and tapered to a point. Host: *E. divaricata*. Distr.: West Virginia.

1b Swelling at base of stem …… *Rhopalomyia weldi* Felt

Galls were found in early spring and described as soft, about 10 mm long and 5 mm wide, single or clustered and purplish. Adults emerged in the same season, so the species presumably forms a summer gall elsewhere on the plant. Host: *E. macrophylla*. Distr.: Illinois.

Euthamia (grass-leaved goldenrod)

This genus has a cecidomyiid fauna not unlike that found on *Solidago*. Fortunately, three studies were made recently (Dorchin et al. 2007, 2009, 2015) that solved several problems concerning the identity of gall makers of both *Euthamia* and *Solidago*. The gall midges of *Asphondylia* and *Rhopalomyia* are of particular interest because their species have at least two generations per year that are responsible for galls on different parts of the plant or on alternate hosts. Gall midges of those genera are associated exclusively with live plant tissue, so overwinter in the crown or rhizomes.

1a Simple stem swellings, leaf blisters or variously joined leaves …… 2
1b Complex galls or modified buds or flowers …… 5
2a Tapered woody swelling at base of stem …… *Lasioptera cylindrigallae* Felt

The gall was originally recorded from a "*Solidago* sp." but later attributed to *E. graminifolia*

as well (Felt 1918a). The type series of this species fits *Lasioptera solidaginis*, which forms a similar gall on *Solidago*. The gall midge is probably univoltine. Host: *E. graminifolia*. Distr.: New York and Pennsylvania.

2b Blisters on leaves or green stems, or variously joined leaves 3
3a Black or purple blister on leaves or green stems, Plate 39 (1e, h) .... *Asteromyia euthamiae* Gagné

Galls are usually black, often bordered with purple. The circular leaf galls may dehisce separately from the leaves. This species has several generations per year and presumably overwinters as full-grown larvae in the last generation of galls. The name *A. euthamiae* may comprise more than one species on *Euthamia*, especially in southern United States. Hosts: *E. caroliniana*, *E. graminifolia*, *E. leptocephala*. Distr.: eastern North America. Gagné 1968a.

3b Gall composed of 2-4 loosely or tightly joined leaves 4
4a Gall composed of 2-4 loosely joined, puckered leaves forming a pouch, see Image 19 .... *Dasineura carbonaria* Felt

The cluster of affected leaves may be yellowish green to purple and 3-8 cm long. The yellow larvae live gregariously inside the leaf cluster. Full-grown larvae drop to the soil to pupate. There are 2-3 generations per year. Galls are apparent in May through August. Host: *E. graminifolia*. Distr.: Northeastern United States. Dorchin et al. 2007.

4b Gall a biconvex blister made by two partially conjoined leaves, Plate 39 (1g) .... *Asphondylia pseudorosae* Dorchin

Each of the two leaves involved contributes one of the tightly joined halves of the ovoid, 4-5 mm diameter, single-chambered, white-fungus-lined gall. Galls are similar to those formed on *Solidago* by *Asphondylia solidaginis*. The gall maker is multivoltine and causes the bud gall of couplet 7a. Host: *E. graminifolia*. Distr.: New York and Masachusetts to Virginia. Dorchin et al. 2015.

5a Elongate, ribbed, conical or spindleform gall on leaf, stem, or flower 6
5b Leafy flower or bud gall 7
6a Gall attached to leaf by pedicel, Plate 39 (1c) ..... *Rhopalomyia pedicellata* Felt

Galls are monothalamous and green to purple. The gall midge is apparently multivoltine and presumably overwinters as an early instar in plant crown tissue. Host: *E. graminifolia*. Distr.: Maine to Minnesota, south to Virginia. Dorchin et al. 2009.

6b Gall sessile, broadest at base, Plate 39 (1f) ..... *Rhopalomyia fusiformae* Felt

Galls are monothalamous and green to purple. The biology is probably similar to that of *R. pedicellata* of couplet 6a. Hosts: *E. graminifolia*, *E. caroliniana*. Distr.: Massachusetts and New York, south to Maryland. Dorchin et al. 2009.

7a Gall a foreshortened branchlet composed of several imbricated leaves or aborted, unopened flower bud with unmodified bracts, Plate 39 (1a) …… *Asphondylia pseudorosae* Dorchin

A central chamber at the center of the gall encloses the larva or pupa. This species also forms the biconvex leaf gall of couplet 4b. The bud gall is often attacked by the larger larva of *Youngomyia podophyllae* (Felt), which replaces the *Asphondylia* larva, whether as an active predator or fatal inquiline. Gregarious yellow larvae of a benign inquiline, *Clinodiplosis comitis* Dorchin, can sometimes be found in outer bracts of the branchlet gall. Several generations of this inquiline may appear in a season; their mature larvae drop to the soil to pupate and emerge about two weeks later. Host: *E. graminifolia*. Distr.: New Hampshire to Maryland and Florida. Dorchin et al. 2015.

7b Elongate-globular, spongy gall, wholly or partially enveloped by one or more enlarged leaves, Plate 39 (1d) …… *Rhopalomyia lobata* Felt

Galls are light green, mono- or polythalamous and occur in both apical and lateral buds. Adults emerge in summer. The overwintering site of the larvae is unknown. Host: *E. graminifolia*. Distr.: Maine, New York, Pennsylvania and Illinois. Dorchin et al. 2009.

Eutrochium (joe-pye weed)

1a From barely swollen leaf midribs or leaf petioles …… *Neolasioptera* sp.

Larvae were found in mid-October. Host: *Eutrochium sp.* Distr.: Iowa. See on BugGuide.

1b From axillary buds or inflorescence …… 2
2a Foreshortened, round, hairy, axillary buds …… *Clinodiplosis* sp.

Galls were found in mid-August. Host. *E. purpureum*. Dist.: Iowa. See on BugGuide.

2b From inflorescence …… 3
3a In foreshortened, swollen flower bud, Plates 38 (12), 40 (1-4) ……
…… *Anthodiplosis eutrochii* Gagné, *Dasineura purpurea* Felt and *Clinodiplosis* spp.

A. eutrochii. This species is responsible for the gall. Larvae are yellow with a light-green midgut and live among the imbricated bracts of the aborted flower bud. In the mid-Atlantic Region, larvae drop to the soil in August and September. Some adults emerge in September, some the following spring. The predaceous *Lestodiplosis grassator* (Fyles) has emerged from typical galls in West Virginia. Hosts: *E. dubium, E. fistulosum*, *E. purpureum*. Distr.: widespread eastern North America.

D. *purpurea*. This species was long ago associated with the gall but has not been reported from the plant since 1908 when originally described. Host: *Eupatorium* sp. Distr.: New York.

Clinodiplosis spp. Two species of this genus other than the gall maker have been reared from the galls, but their larvae were found among the outer bracts. Host: *E. dubium*. Distr.: West Virginia.

3b From flower head without apparent malformation …… *Neolasioptera* sp.

Adults were reared from flowers in late August, but the specific site of infestation is unknown. Host: *E. fistulosum*. Distr.: West Virginia.

Flaveria (yellowtops)

Tapered stem swelling …… *Neolasioptera* sp.

Adults emerged from the stems in April and May. Host: *F. linearis*. Distr.: Florida.

Flourensia (tarwort)

Swollen bud …… *Asphondylia* sp.

Lateral buds are swollen at their bases, are 4-5 mm long to 3 mm wide, with only a few short leaves growing from their tips. Host: *F. cernua*. Distr.: New Mexico.

Galinsogeopsis (rock daisy)

Larva in flower head …… *Dasineura* sp.

This unidentified species is known only from a series of adults in the USNM. Host: *P. coronopifolia*. Distr.: Arizona.

Gnaphalium (cudweed)

Narrowly ovate bud gall …… *Asphondylia* sp.

The gall is white-woolly and about 20 mm long and 10 mm in diameter (Felt 1940, 1965). Host: *Gnaphalium* sp. Distr.: New Brunswick (ex Felt's unpublished notebook).

Grindelia (gumweed)

1a Leaf blister …… *Asteromyia modesta* (Felt)

Galls are 3-5 mm in diameter and show little or no discoloration except for some slight chlorosis. Unlike other species of *Asteromyia*, *A. modesta* appears not to have an associated fungus. It is multivoltine. Hosts: *G. camporum*, *G. hirsutula*, *G. humilis* and *G. squarrosa*; also *Conyza canadensis*, *Erigeron* spp. and *Solidago* spp. Distr.: Maryland, Minnesota, Texas, California and Oregon. Gagné 1968a.

1b Floret or bud gall 2
2a Modified, aborted floret, Plate 41 (1) ..... *Rhopalomyia grindeliae* Felt

Galls are capsulelike, hard, sticky and about 5 mm long. Flower heads with many galls can become abnormally large. Adults emerge from the apex of the galls in October. They may also form a yet unknown overwintering gall on a different part of the plant. Host: *G. cuneifolia*, *G. hirsutula*, *Grindelia* spp. Distr.: California. Russo 2021.

2b Leafy rosette or swollen bud 3
3a Leafy rosette gall, Plate 41 (2) ..... cecidomyiid

Galls are monothalamous, up to 2 cm long, elongate-ovoid and formed of overlapping bracts. Host: *G. lanceolata*, *G. hirsutula*. Distr.: Arkansas, California. Wells 1921b, Russo 2021.

3b Globular bud gall, Plate 41 (3) ..... *Rhopalomyia* sp.

Galls are firm, green, one- to several-chambered, less than 1 cm long and usually found in axils of leaves. Host: *G. squarrosa*. Distr.: Kansas, Oklahoma.

Gutierrezia (snakeweed, matchweed)

1a Black blister on leaf or stem, Plate 38 (14) ..... *Asteromyia gutierreziae* Felt

Galls are usually monothalamous. The gall midge is probably multivoltine. Hosts: *G. microcephala*, *G. sarothrae*; also *Baccharis angustifolia*, *Gymnosperma glutinosum*. Distr.: Utah to New Mexico, west to California. Gagné 1968a.

1b Bud galls 2
2a Non-leafy bud galls 3
2b Leafy or bracteate bud galls 4
3a Hard, ovoid, glabrous gall, Plate 45 (4) ..... *Rhopalomyia gutierreziae* (Cockerell)

Green, red or tan, 5-8 mm long by 3-5 mm wide, these galls appear at the tips of branchlets. Adults were reared in July, also in October, so at least two generations occur per year. At any one time these populations may be in various stages. Host: *G. sarothrae*. Distr.: Montana to New Mexico and west. Russo 2021.

3b Fleshy, spheroid, matte gall ..... cecidomyiid

The gall is succulent and monothalamous, usually green with some red, about 8 mm in diameter and becoming wrinkled. Host: *G. microcephala*. Distr.: California. Russo 2021.

4a Ovoid gall tightly covered with bracts, see Image 20 ..... *Asphondylia* sp.

Galls are about 8 mm long and monothalamous. The ends of many bracts are recurved. Adults emerged just before plants bloomed. Host: *Gutierrezia* sp. Distr.: Arizona.

4b Spheroid galls, loosely covered with broad or radiating, narrow bracts 5
5a Bracts few, much wider at base than apex, Plate 42 (1) ..... *Rhopalomyia* sp.

Galls are monothalamous. Host: *Gutierrezia* sp. Distr.: Oregon.

5b Bracts many, linear and radiating, Plate 42 (2) ..... *Rhopalomyia* sp.

Galls are monothalamous. Host: *Gutierrezia* sp. Distr.: Oregon.

Gymnosperma (gumhead)

Black blister on leaf and green stem ..... *Asteromyia gutierreziae* Felt

Galls are black, elliptical, slightly convex and 3-8 mm in diameter. One to several larvae occur in a gall. Hosts: *G. glutinosum*; also *Baccharis angustifolia* and *Gutierrezia* spp. Distr.: Texas to Arizona, and Nuevo Leon. Gagné 1968a.

Hazardia (sawtooth goldenbush)

Knobby, multichambered swelling at branch apex with aborted flowers ..... Rhopalomyia sp.

Host: *H. squarrosa*. Distr.: coastal California.

Helenium (sneezeweed)

1a Larva in stem, not always associated with a swelling ..... *Neolasioptera* sp. and *Resseliella* sp.

Neolasioptera sp. Larvae were found in separate tunnels in the stem. Host: *H. autumnale*. Distr.: Iowa, Wisconsin.

Resseliella sp. Gregarious larvae were found in the pith. The affected stem showed no enlargement. Host: *Helenium* sp. Distr.: Ontario.

1b Larva in swollen bud or flowers 2
2a Swollen, globular, leafy, apical bud gall, Plate 41 (4) ..... *Asphondylia autumnalis* Beutenmüller

Galls are green, succulent, polythalamous and variable in shape and size. Adults emerge from the galls in late summer, so the species may overwinter in another gall in the crown of the plant. Host: *H. autumnale*. Distr.: North Carolina and Missouri.

2b Aborted, galled flower or larva crawling freely among flowers 3
3a In modified, aborted flower ..... *Asphondylia* sp.

Galls are monothalamous and formed of the enlarged but scarcely thickened corolla of the disk flower. Flowers are about three times the normal width and protrude slightly above the

tops of other disk flowers. Adults emerge from the galls in December. Host: *H. microcephalum*. Distr.: Texas. Painter 1935.

3b Larva crawling freely among flowers …… *Clinodiplosis autumnalis* Plakidas

Gregarious larvae may be found among the flowers in autumn. When full-grown they drop to the soil to overwinter. Host: *H. autumnale*. Distr.: Pennsylvania.

Helianthus (sunflower)

1a Galls or free-living larvae in flower head …… 2
1b Galls of stem, node, bud, or leaf …… 4
2b Free-living larvae in or among florets …… *Contarinia* spp.

Contarinia schulzi Gagné. This can be a major pest of commercial sunflowers. Larvae attack disc flowers, cause gnarled receptacles, greatly reduced seed production, and lead to subsequent rot. The species is multivoltine. Full-grown larvae drop to the soil to pupate. Host: *H. annuus*. Distr.: North Dakota to Texas. Schulz 1973.

Contarinia sp. This species is anatomically distinct from *C. schulzi*. Its biology may be similar. Hosts: *H. ciliaris*, *H. petiolaris*. Distr.: Kansas and Texas. Rogers et al. 1979.

2a Galls of achenes or florets …… 3
3a Slightly swollen achene …… *Neolasioptera helianthi* (Felt)

Infested achenes appear normal or slightly swollen. Larvae pupate inside the achenes and adults emerge through a hole at the top. At least two generations occur per year. Heavily infested flower heads produce leaves in the center. Hosts: *Helianthus* spp. Distr.: widespread in North America. Rogers et al. 1979.

3b Deformed florets and pedicels or associated with flowers, see Image 21 …… …… *Asphondylia helianthiflorae* Felt and *Helianthecis capitum* Gagné

A. helianthiflorae. This species was originally reared in late August from unspecified flower galls found in New York. It presumably causes floret deformation and may be a synonym of *Asphondylia helianthiglobulus* (couplet 7a) found in buds of this host. Hosts: *Helianthus decapetalus*, *H. occidentalis*, *Helianthus* sp. Distr.: New York, West Virginia.

H. capitum. Its niche in the flower heads is not known but was originally thought to be the floral ovaries. This species was treated tentatively in Rogers et al. (1979) as *Mayetiola* sp. and later in Gagné 1989 as *Dasineura* sp. Hosts: *H. annuus*, *H. grosseserratus*, *H. petiolaris*. Distr.: North Dakota to Texas. Gagné 2016c.

4a Convex leaf gall …… 5
4b Gall on bud, node, or stem, rarely leaf …… 6
5a Hemispherical, hairless gall with knobby surface, Plate 41 (8) ……

…… *Pilodiplosis helianthibulla* (Walsh)

Galls are less strongly convex on the lower leaf surface from which the adults emerge in late summer. Hosts: *H. annuus*, *H. decapetalus*, *H. divaricatus*, *H. grosseserratus*, *H. strumosus*, *H. tuberosus*. Distr.: Iowa and Missouri to New York and Ontario.

5b Irregular blister gall with usual leaf texture, see Image 22 …… *Asphondylia* sp.

Galls are usually laminar. The gall former has not been critically studied but the gall may be a further manifestation of *Asphondylia helianthiglobulus* of couplet 7. Host: *Helianthus annuus*. Distr.: Oklahoma.

6a Tubular gall on all plant parts, usually at nodes, Plate 41 (7) …… *Olpodiplosis helianthi* (Brodie)

Galls are mono- or polythalamous and highly variable in shape and length. The open, reflexed ends are filled with fine hair. Adults emerge through the open end in late spring and summer, so this species is at least bivoltine. Hosts: *H. annuus*, *H. decapetalus*, *H. divaricatus*, *H. strumosus*, *H. tuberosus*. Distr.: Ontario to Iowa, south to Texas. Breland and Schmitt 1948.

6b Convex, succulent galls along stem, fusiform woody swelling, or apparently normal stem … 6
7a Convex, succulent swelling along stem or bud, Plate 41 (5) ……
…… *Asphondylia helianthiglobulus* Osten Sacken

Galls are variable in size, 5-15 mm in diameter, usually green, occasionally purple. Adults emerge from the galls in summer. The overwintering generation presumably develops in the plant crown. Hosts: *H. annuus*, *H. decapetalus, H. divaricatus*, *H. grosseserratus*, *H. heterophyllus*, *H. mollis*, *H. neglectus*, *H. niveus*, *H. occidentalis*, *H. petiolaris*, *H. praecox*, *H. strumosus*, *H. tuberosus*. Distr.: widespread North America. Rogers et al. 1979.

7b Woody stem swellings or apparently normal stem …… 8
8a Woody stem swelling, Plate 41 (9) …… *Neolasioptera* spp.

N. thurstoni (Brodie). This species is probably univoltine. Hosts: H. *divaricatus* and *Helianthus* spp. Distr.: widespread North America.

Neolasioptera spp. Two additional species with larvae distinct from those of *N. thurstoni* and each other are known from stems. One species was taken from *Helianthus eggertii* in Tennessee and *H. divaricatus* in Oklahoma, the other was from *Helianthus angustifolius* in Texas. Rogers et al. 1979.

8b From apparently normal stem …… *Resseliella* sp.

Gregarious orange-red larvae were found tunneling in pith. Host: *H. annuus*, *Helianthus* sp. Distr.: Virginia, Texas.

Heliomeris (false goldeneye)

Swollen stem …… *Neolasioptera* sp.

Adults emerged in spring from galls collected in winter. The fusiform swellings were barely noticeable. Host: *H. longifolia*. Distr.: Arizona.

Hymenoclea (see *Ambrosia*)

Hymenopappus (hymenopappus)

Larva free in flower head …… *Contarinia* sp. and *Dasineura* sp.

Larvae of both genera were found crawling among florets. Host: *H. flavescens*. Distr.: Texas.

Hypochaeris (catsear)

From swollen stem formed by a cynipid wasp …… *Lasioptera* sp.

Adults were reared in July and August from stem deformations caused by *Phanacis hypochoeridis* (Kieffer) (Hymenoptera: Cynipidae). Host: *H. radicata*. Distr.: Oregon.

Ionactis (aster)

Swollen, foreshortened plant apex …… *Dasineura* sp.

The gall is long, spindleform, reddish, ca 1 cm long and partially incorporates leaves growing along its length. Distr.: Massachusetts. Host: *Ionactis linariifolia*. Eiseman & Blyth 2022.

Iva (marsh elder)

1a Tapered stem swelling …… *Neolasioptera* sp.

Swellings are reportedly about 25-30 mm long and 6 mm at the widest diameter. Host: *Iva frutescens*, *I. imbricata* Distr.: Massachusetts, Florida.

1b Bud swellings …… 2
2a Fuzzy pea-shaped node gall …… *Dasineura* sp.

Host: *I. angustifolia*. Distr.: Oklahoma, Texas. Rogers 1977.

2b Glabrous, apical gall …… *Asphondylia borrichiae* Rossi & Strong

Hosts: *I. imbricata*; also *Borrichia frutescens* (q.v.). Distr.: Florida. Rossi and Stiling 1995, Stiling et al. 1992.

Krigia (dwarf dandelion)

Larvae in agromyzid leaf mine …… *Dasineura* sp.

Larvae were found in early April in mines of *Ophiomyia* sp. (Agromyzidae). Adults of the cecidomyiid emerged in mid-May. The species belongs to *Dasineura* only in the broad sense. Host: *Krigia virginica*. Distr.: North Carolina.

Lactuca (wild lettuce)

Tapered, woody stem swelling, Plate 42 (11) …… *Lasioptera lactucae* Felt

Galls are 10-30 mm long and usually near the base of the stem. Larvae are yellow, gregarious. Host: *L. canadensis*. Distr.: New Hampshire to West Virginia and Maryland.

Liatris (blazing star)

Irregular, subspherical bud gall …… *Asphondylia lacinariae* Felt

Galls are polythalamous, 20 mm long by 15 mm wide. Adults emerged in early spring. Host: *L. punctata*, *L. pycnostachya*. Distr.: Kansas, Missouri, Arkansas and Texas.

Matricaria (see *Tripleurospermum*)

Melanthera (squarestem)

Spheroidal, fleshy flower or flower bud gall …… *Asphondylia* sp.

Whole flower buds or only a few florets may be modified into galls. Adults emerge in mid-January in southern Florida. Host: *M. parvifolia*. Distr.: Florida.

Mikania (hempvine)

1a From unspecified gall in flower head …… *Neolasioptera* sp.

The particular feeding site of this species is unknown. Other *Neolasioptera* spp. from flower heads of asteraceous plants live in achenes or pedicels. Adults were reared in early November. Host: *Mikania scandens*. Distr.: Florida.

1b Tapered to bulbous stem swelling, Plate 42 (3) …… *Neolasioptera perfoliata* Felt

The stems are hollow. The crowded larvae eventually form cocoons, which line up longitudinally. Larvae overwinter in the stems. Host: *M. scandens*; also *Eupatorium* spp. (q.v. for more details). Distr.: Connecticut and New York to Florida.

Oligoneuron. See ***Solidago***.

Packera (ragwort)

Bulbous galls at base of plant ..... *Asphondylia pruinosa* Plakidas

The polythalamous galls may be as large as 1 cm in diameter and are situated just above the root. Adults emerge in spring. A summer generation presumably exists. Host: *P. aurea*. Distr.: Pennsylvania.

Palafoxia (palafox)

1a Spheroid apical gall, see Image 23 ..... *Asphondylia* sp.

Galls are fleshy and 1-2 cm in diameter. Adults emerged in mid-March from apical galls found in east central Florida. Another report found similar galls later in the season on flower heads. The inquiline *Youngomyia podophylli* Felt was reared from flower head galls. Host: *P. feayi*. Distr.: Florida.

1b Stem and flower pedicel swellings ..... *Neolasioptera* sp.

Host: *P. feayi*. Distr.: Florida

Parthenium (feverfew)

White, trumpet-shaped galls with erect white hairs on axillary buds, young leaves, or inflorescence, Plate 27 (9) ..... *Contarinia partheniicola* (Cockerell)

Galls are 5-8 mm long, 4-5 mm wide and occur singly or in groups. Adults were reared in late summer, winter and spring, so several generations occur per year. Hosts: *P. incanum*; also *Ambrosia* spp. Distr.: New Mexico and California. Russo 2021.

Pluchea (camphorweed)

From unspecified damage in flower head ..... *Asphondylia* sp.

This unidentified species is known only from a series of adults in the USNM that were reared in April. Host: *P. rosea*. Distr.: Florida.

Polymnia (leafcup)

Under outer bark and in slightly swollen petioles ..... *Neolasioptera* sp.

Adults emerged in early August. Host: *P. canadensis*. Distr.: Iowa. See on BugGuide.

Prenanthes (rattlesnakeroot)

1a Flat, ovoid, purplish leaf blister ..... *Cystiphora canadensis* Felt

Galls are approximately 3-5 mm in diameter. This species probably has several generations per year, as do other species of *Cystiphora*. Eggs are inserted through the stomatal openings of developing leaves by means of a short, rigid, pointed ovipositor. Hosts: *P. alba*, *P. altissima* and *P. serpentaria*. Distr.: Maine and Ontario. DeClerck and Steeves 1988.

1b In achene ..... cecidomyiid

A full-grown larva was noticed in early October as it was exiting from a hole near the base of an achene. Host: *P. alba*. Distr.: Iowa. See on BugGuide.

Pseudognaphalium (cudweed)

1a Stem swelling, Plate 38 (16) ..... *Asphondylia* sp.

Swellings are additionally marked by having longer surrounding hairs than elsewhere on the stem. Host: *Pseudognaphalium* sp. Distr.: Oregon.

1b Spheroid bud gall, see Image 24 ..... *Asphondylia* sp.

Galls are soft and woolly, 1.0-2.0 cm long by 1.0-1.5 cm in diameter. A gall may contain 20 larvae, each in its own chamber. Hosts: *Pseudognaphalium californicum*, *P. microcephalum*. Distr.: California. Russo 2025.

Ratibida (prairie coneflower)

Deformed, aborted floret, Plate 42 (7) or swollen apical bud ..... *Asphondylia ratibidae* Felt

Galls are monothalamous. This species has at least two generations per year. In summer the galls are in the flower heads. Infested florets are swollen and remain closed. From August to October, galls are found in enlarged stem ends or leaf buds. Adults emerging in October must lay eggs on living plant tissue, so this species presumably has a winter/spring bud gall as well. Host: *R. columnifera*, *R. pinnata*, *Ratibida* spp. Distr.: Texas to Iowa. Painter 1935. See on BugGuide.

Rudbeckia (coneflower)

1a Larvae free among bracts and flowers ..... *Contarinia rudbeckiae* Plakidas

Host.: *R. laciniata*. Distr.: Pennsylvania.

1b Associated with deformations on various plant parts 2a
2a Tapered stem or petiole swelling ..... *Neolasioptera rudbeckiae* (Felt)

The swelling may be prominent to slight. This species has been found in the pith with no

accompanying stem enlargement and in barely swollen petioles of fall-growth leaves. It has also been reared from soft tissue in galls of *Asphondylia rudbeckiaeconspicua*. More than one generation per year may occur. Host: *R. laciniata*. Distr.: Iowa, New York, Pennsylvania and Virginia. See on BugGuide.

2b Bud or flower gall 3
3a Globular, succulent bud gall at base of plant in spring or apex of plant in summer, Plate 42 (9-10) ..... *Asphondylia rudbeckiaeconspicua* Osten Sacken

Galls are large and polythalamous. Summer galls begin development in June and July. Leaves and an occasional flower petal grow from their tips. Adults emerge from these galls in late summer and lay eggs in the next year's buds at the base of the plant, from which the next generation will emerge the following June. Hosts: *R. laciniata*, *R. triloba*. Distr.: New York to Alabama. Plakidas 1988.

3b Leafy flower head, Plate 42 (8) ..... cecidomyiid

The gall maker is unknown. A predaceous cecidomyiid, *Lestodiplosis rudbeckiae* (Beutenmüller), was reared from such galls. Host: *R. hirta*. Distr.: North Carolina.

Schistocarpha (schistocarpha)

From unspecified flower head damage ..... *Asphondylia* sp. and *Neolasioptera* sp.

Adults of both species were reared in November. Host: *S. eupatorioides*. Distr.: Veracruz.

Senecio (ragwort)

1a Swollen stem ..... *Lasioptera arizonensis* Felt

Adults emerged in spring from circular holes in stems. Host: *S. arizonensis*. Distr.: Arizona.

1b Enlarged, aborted bud or swollen, sterile floret 2
2a Enlarged, aborted bud ..... *Asphondylia* sp.

This species is known from only a gall and pupa in the USNM. Host: *S. flaccidus*. Distr.: Sonora.

2b Swollen, sterile floret ..... *Asphondylia bea* Felt

Infested florets are swollen at the base and remain closed apically. Flower heads with several galls become deformed. Successive generations emerge during the flowering period in southern California. Host: *S. flaccidus*. Distr.: California. Needham 1925.

Sericocarpus (white-topped aster)

Loose rosette of wide, short leaves, Plate 34 (10-11) …… *Asphondylia recondita* (Osten Sacken)

Galls are 10-20 mm long and occur at the tips of branches. The single larval chamber is at the center of the gall. Adults emerge from the gall in summer. Hosts: *Sericocarpus asteroides, Symphyotrichum novae-angliae*, *S. patens*. Distr.: New York to North Carolina.

Smallanthus (smallanthus)

From unspecified gall in flower head …… *Asphondylia* sp.

Adults were reared in November. Host: *S. maculatus*. Distr.: Chiapas.

Solidago (goldenrod)

The key to galls that follows is helped greatly by recent comparative studies on goldenrod galls in Pennsylvania (Dorchin et al. 2007, 2009, 2015). Those papers further reveal the natural history and taxonomy of this large cecidomyiid fauna, especially that of two speciose genera, *Asphondylia* and *Rhopalomyia*. These are of particular interest because their species have more than one generation per year that are formed either on separate parts of a single species or on alternate species. In temperate zones, species of *Asphondylia* and *Rhopalomyia* require live plant tissue in which to overwinter, so their last generation of the year must be spent in winter-hardy crowns or rhizomes of goldenrods. This contrasts with, e.g., *Asphondylia ambrosiae* and *Rhopalomyia ambrosiae*, gall makers on ragweed in more southern United States, that cannot survive farther north where vegetative parts of that plant die back completely in winter.

Rhopalomyia cruziana Felt, was taken from an unspecified flower gall on a goldenrod in southern California, so does not appear in the present key.

1a Woody fusiform basal swelling or spongy lateral outgrowth of the main stem …… 2
1b Galls on other plant parts …… 3
2a Swelling usually evenly tapered, woody, Plate 44 (5) … *Lasioptera solidaginis* (Osten Sacken)

The gall is found near the base of the stem, up to 10 cm above the soil surface, and has the same exterior texture as the rest of the stem. The pith is soft with elongate, vertical larval tunnels. The size of the gall depends on the number of larvae present; galls are occasionally found that are only slight swellings. Larvae overwinter in the gall and emerge the following spring. One generation occurs per year. Not to be confused with this gall are two other conspicuous woody galls found higher up on the stem, an elongate-fusiform gall made by caterpillars of *Gnorimoschema gallaesolidaginis* (Riley) (Lepidoptera: Gelechiidae) and an evenly spherical "ball gall" formed by *Eurosta solidaginis* (Fitch) (Diptera: Tephritidae). Hosts: *S. altissima*, *S. canadensis*, *S. rugosa*. Distr.: northeastern North America.

2b Swelling usually uneven and to one side of the stem, soft, becoming spongy and mealy, Plate 43 (4) …… *Asteromyia tumifica* (Beutenmüller)

Galls have locally been found slightly higher up on the stem than those formed by *Lasioptera*

solidaginis, presumably an indication of adult emergence time in spring. Individual larval chambers are ovoid. This species is the only *Asteromyia* that is not found in leaves or green branchlets. It is univoltine and larvae overwinter in the galls. Hosts: *S. altissima*, *S. canadensis*, *S. fistulosa*, *S. ulmifolia*. Distr.: eastern North America. Gagné 1969b.

3a Circular or ovoid leaf blister or swollen base of petiole …… 4
3b Bud galls or complex leaf, stem or inflorescence galls …… 6
4a Gall an oval biconvex blister formed from two closely appressed leaves, Plate 43 (3b) ……
…… *Asphondylia solidaginis* Beutenmüller and *Asphondylia rosulata* Dorchin

A. solidaginis. Each of the two leaves involved contributes one of the tightly joined halves of the ovoid, 4-5 mm diameter, single-chambered gall with a white fungus-lined interior. Only occasionally do three or four leaves make up a single gall. This species is multivoltine. It is also responsible for leafy galls (couplet 11a) that develop later in the season. Two inquilinous gall midges, *Trotteria caryae* (Felt) and *Camptoneuromyia adhesa* (Felt), have been reared from these galls. Hosts: *S. altissima*, *S. canadensis*, *S. gigantea* and *S. rugosa*. Distr.: northeastern North America. Dorchin et al. 2015.

A. rosulata. This species also forms two kinds of galls, both similar to those of *A. solidaginis*, the biconvex blister galls made of closely appressed leaves in spring and early summer and the bud galls (couplet 11a) later in summer. Hosts. *S. rugosa* and occasionally *S. gigantea*. Distr.: Massachusetts, Pennsylvania, West Virginia, Maryland. Dorchin et al. 2015.

4b Circular or lunate, black or variously colored blister on single leaf, or swollen, green pulvinus at base of leaf …… 5
5a Circular or lunate, white, black or variously colored leaf blister, Plate 43 (3a) … *Asteromyia* spp.

A. carbonifera (Osten Sacken). Galls contain a white symbiotic fungus that turns hard and black as the larva matures. The growing larvae remain stationary within the galls with their mouthparts in contact with a spot of green tissue. Gagné (1968a) may have treated this species too broadly; it may well be a complex of species (Stireman et al. 2010). It is multivoltine and found on most goldenrods across North America. Development from egg to adult takes 4-5 weeks. One to more than 10 larvae occur per gall, each in its own chamber. As the season progresses, galls appear on the new leaves that develop progressively farther up the stem. Gall color is characteristic of the host species. Size is variable, 5-15 mm in diameter on *S. canadensis* with one to several larvae, each in their own chamber, 3-4 mm in diameter on *S. juncea* with a single larva. A *Camptoneuromyia* sp. was found in association with *Asteromyia* leaf blister galls (Weis 1982a). The cocoons in which the *Camptoneuromyia* larvae pupate can sometimes be seen on leaves close by the galls; Weis (1982a) reported its larvae feeding in the outer layers of the galls. Hosts: most species of *Solidago*. Distr.: coast to coast in North America. Gagné 1968a, Stireman et al. 2010, Heath & Stireman 2010).

A. modesta (Felt). This species is much less common on goldenrod than *A. carbonifera* and, unlike the latter, often does not have a fungal associate. The larva inhabits the mesophyll layer of the leaf and forms a convexity on only the upper surface. The swelling is accompanied by only slight discoloration of the green leaf. Hosts: *S. flexicaulis*, *S.*

macrophylla; also *Erigeron* spp., *Conyza* sp. and *Grindelia* spp. Distr.: northeastern North America. Gagné 1968a, Stireman et al. 2010.

5b Swollen, green base of pulvinus, see Image 25 ..... *Asteromyia* sp.

The gall of this undescribed species is noticeable in late summer on leaves growing on the upper third of the stems. Second and third instars are present in mid-September and only third instars in mid-October in a chamber lined with white fungus. A swelling of the midvein along the basal third of the leaf that is formed by an unidentified weevil (Coleoptera: Curculionidae) can occasionally occur adjacent to the leaf base and appear similar to the *Asteromyia* gall but is always accompanied internally by frass. Host: *S. altissima*. Distribution: West Virginia, Maryland.

6a Galls leafy or subtended by a rosette of leaves 7
6b Galls neither leafy nor subtended with a rosette of leaves 13
7a Gall a brown, conical, spongy, many-chambered structure subtended by a leafy whorl, Plate 44 (3) ..... *Rhopalomyia hirtipes* (Osten Sacken)

Galls are succulent and polythalamous. Full-grown larvae are white and pupate in late summer. Adults emerge about two weeks later. Eggs of this generation are laid on or near the base of goldenrod stems. These larvae hatch in fall and overwinter as first-instar larvae in meristematic tissue of vegetative buds. At the beginning of the season the galls are found near ground level but later may appear up to 60 cm from the ground. Host: *S. juncea*. Distr.: northeastern United States. Spence 1969, Dorchin et al. 2009.

7b Galls leafy 8
8a Gall a cluster of several incurved leaves with puckered surface containing gregarious larvae, see Image 19 ..... *Dasineura folliculi* Felt

Galls appear on foreshortened apical stems as short, basally widened leaves, 4-8 cm long and 1-3 cm wide. The leaves are initially tightly wrapped but later unfurl. Bright orange gregarious larvae live among the leaves in the cluster and eventually drop to the soil when full-grown. Several overlapping generations occur per season. White larvae of *Macrolabis americana* Dorchin (2006), an inquiline, are regularly found in the galls. Larvae of an inquilinous cecidomyiids *Youngomyia* sp. and predaceous *Lestodiplosis* spp., the sciarid *Bradysia coprophila* Lintner, as well as plant feeding caterpillars, can occasionally also be found in the galls. The name *D. radifolii* Felt that was used for this gall in Gagné (1989) is now a junior synonym of *D. folliculi*. Hosts: *S. gigantea*, *S. rugosa*, *S. rigida*, *S. sciaphila* and possibly other species. Distr.: eastern North America. Dorchin 2006 et al., Dorchin et al. 2007. See on BugGuide.

8b Bud galls composed of a number of shortened leaves surrounding one to many, closed, monothalamous chambers 9
9a Gall a leafy sprout or rosette found near the crown of *S. altissima* in spring .... *A. monacha* Osten Sacken

This is the year's first generation of *A. monacha*. The second generation produces similar galls that are found at the apices of *S. juncea* and relatives in June and later (couplet 12). Hosts: *S. altissima* in spring and *S. juncea*, *S. erecta* and *S. uliginosa* in summer. Distr.: northeastern North America. Dorchin et al. 2015.

9b Gall on apical or lateral buds of various species, found in summer 10

10a Gall inconspicuous, at apex of plant and composed of two or three foreshortened leaves encompassing a larval chamber ..... *Asphondylia silva* Dorchin

At least two generations can be found in summer. Host: *S. caesia*. Distr.: Pennsylvania. Dorchin et al. 2015.

10b Gall a conspicuous rosette of leaves, 1-2 cm wide 11

11a Leaf rosette surrounding single conelike structure at center, Plate 43 (2d) .... *Asphondylia solidaginis* Beutenmüller, *Asphondylia rosulata* Dorchin, *Asphondylia pumila* Plakidas and inquilines or successors, *Dasineura* spp.

A. solidaginis. The rosette gall is found in mid-to-late summer and formed of several leaves surrounding a single centrally located chamber formed of shortened, closely juxtaposed leaves. A single larva typically occupies the chamber and the adult leaves in summer. This species is also responsible for the biconvex blister gall formed from two closely appressed leaves (couplet 4a) that develops in spring and early summer. One leaf rosette gall was found in West Virginia filled with several bright red larvae of a *Dasineura* that were very active when released. This *Dasineura* is not the same species as reported in the next entry for *A. rosulata*. Host: *S. altissima*. Distr.: northeastern North America. Dorchin et al. 2015.

A. rosulata. This species forms two kinds of galls similar to those of *A. solidaginis*, a biconvex blister gall made of closely appressed leaves in spring and early summer and the bud gall later in summer. See Image 26. A single larva typically occupies the chamber. The adult departs in summer. An inquilinous species of Eulophidae often replaces the interior of the gall with several, hard, spherical, white-surfaced black galls. See Image 27. In West Virginia one gall was found with a second level of inquilines, yellowish larvae of a *Dasineura* living among the eulophid galls. This *Dasineura* is distinct from the one reported in the previous paragraph concerning *A. solidaginis*. Host. *S. rugosa*. Distr.: Pennsylvania, West Virginia, Maryland. Dorchin et al. 2015.

A. pumila. The summer gall made by this species is also a leafy rosette, but with one or more separate, central, conical chambers. Emerging adults are responsible for crown galls that develop the following spring. Host. *S. patula*. Distr.: Pennsylvania. Plakidas 2018.

11b Cabbage-like gall comprised of many separate, closely juxtaposed, individual galls 12

12a Individual galls long-leafy, each enclosing a chamber lined with a white fungal mycelium, Plate 44 (1, 2) ..... *Asphondylia monacha* Osten Sacken and *Asphondylia* spp.

A. monacha Osten Sacken. Galls are apparent by June on *S. juncea* and through the rest of summer. Adults emerge by end of summer when they presumably lay their eggs in the base

of their alternate host, *S. altissima* (see couplet 9a). The summer galls are analagous to those on *S. altissima* and relatives that are formed by *Rhopalomyia solidaginis* (see couplet 12b). Orange larvae of an inquiline, *Youngomyia podophyllae* (Felt), may be found, one or more of them to a chamber in late August in Maryland, when the *Asphondylia* larvae are still only in their second instar. When full-grown, *Youngomyia* larvae break out of the gall and drop to the soil. Empty *Asphondylia* larval skins were found in galls vacated by the inquiline (Dorchin et al. 2015). Hosts: *S. juncea*, *S. erecta* and *S. uliginosa*. Distr.: Maine to Virginia west to Minnesota. Dorchin et al. 2015.

Asphondylia spp. Hosts: *S. bicolor* and *S. sempervirens*. Distr.: Pennsylvania. Dorchin et al. 2015.

12b Individual galls also long-leafy but enclosing one to several closed, ampule-like larval chambers containing no fungal mycelium, Plate 43 (2d) …… …… *Rhopalomyia capitata* Felt and *Rhopalomyia solidaginis* (Loew)

R. capitata Felt. Galls are found mainly on *S. gigantea*, at least in central Pennsylvania. This species lives in one to several vertical, elongate chambers at the very center of the gall. The species has two generations per year that form similar galls. Both occur at the plant apex, but the spring galls occur closer to the ground on plants that have yet to attain their full height. The later, summer galls are more conspicuous. Hosts: *S. gigantea*, *S. altissima* and *S. leavenworthii*. Distr.: northeastern North America. Dorchin et al. 2009.

R. solidaginis (Loew). Galls are found mainly on *S. altissima*, at least in central Pennsylvania. Galls and biology of this species are generally similar to that of *R. capitata*. Hosts: *S. altissima*, *S. canadensis* and *S. rugosa*. Distr.: New York to North Carolina. Dorchin et al. 2009.

13a Bulblet-like galls at base of stem or on rhizomes, Plate 44 (4, 6) …… *Rhopalomyia bulbula* Felt, *Rhopalomyia hirtipes* (Osten Sacken) and *Rhopalomyia thompsoni* Felt

R. bulbula. Galls are ovoid, smooth, white and found in clusters on rhizomes at the base of spring shoots. Presumably a summer generation exists also, but it has not yet been found. Host: *S. juncea*. Distr.: northeastern United States. Dorchin et al. 2009.

R. hirtipes. See couplet 7a. Host: *S. juncea*. Distr.: northeastern United States. Spence 1969, Dorchin et al. 2009.

R. thompsoni. The bulbous and fleshy galls appear as single to multichambered bulblets on rhizomes. In Pennsylvania the overwintering generation emerges in May and the summer generation in August and September. Host: *S. altissima*. Distr.: northeastern United States. Dorchin et al. 2009.

13b Cylindrical, conical or pyriform growth on flowers, flowering branches, leaves, or stems … 14
14b On leaves and stems…… 15
14a On flower heads or rachises …… 16

15a Gall usually hairy, on *S. altissima*, Plate 43 (3c) ..... *Rhopalomyia clarkei* Felt

Galls are 2-5 mm long, the same color as the leaf, usually with some white hair, although sometimes naked. They usually occur on major veins of the underside of leaves, sometimes on the upper, but may also be found on stems. This species is multivoltine and can be found throughout the season. Hosts: *S. altissima*, *S. rugosa*. Distr.: New Hampshire and Ontario, south to North Carolina. Dorchin et al. 2009.

15b Gall smooth, on *S. juncea* and *S. gigantea* ..... *Rhopalomyia gina* Dorchin and *Rhopalomyia inquisitor* Felt

R. gina. Galls are conical, smooth, green, often with purple, about 3-5 mm long and usually found on the upper side of leaves. The gall may have a curled appendage issuing from the opposite side of the leaf. This species is probably multivoltine and can be found throughout the season. Host: *S. juncea*. Distr.: Pennsylvania, Maryland. Dorchin et al. 2009.

R. inquisitor. Conical, smooth gall usually found on the upper side of leaves, about 3-5 mm long. Dorchin et al. (2009) tentatively assigned this gall to this species, which was originally reportedly reared in association with rosette galls of *Rhopalomyia capitata*. See also *Rhopalomyia* sp. of Dorchin et al. (2009) which might possibly be the same species. Host: *S. gigantea*. Distr.: New York.

16a Rachis modified as bulblike galls, each subtended by a bract, see Image 28 ... *Asphondylia* sp.

The group of galls filling the rachis simulates a wand of Brussels sprouts. Adults emerged at end of August. Females emerging from these galls possibly lay eggs for the spring generation at the base of the plant. Host: *S. sempervirens*. Distr.: Maine.

16b Galls inside or replacing flower heads 17

17a Individual heads with yellow, ampule-like gall, a modified floret seated among normal florets ..... *Rhopalomyia guttata* Dorchin

The gall is conical, smooth, white to green, sometimes red, and shorter than a normal floret. They are nearly hidden from view but flower heads with galls are harder to the touch than uninfested flowers. Host: *S. bicolor, S. rigida*. Distr.: Connecticut, Iowa. Dorchin et al. 2009. See on BugGuide.

17b Heads modified into single galls 18

18a Galls naked 19

18b Galls fuzzy 20

19a Gall onion shaped, short-pointed at tip, Plate 43 (2a), see Image 29 ..... *Schizomyia racemicola* (Osten Sacken)

Galls are 5-6 mm long, green to red, smooth, thin-walled and weakly ribbed. Larvae are orange, very active and leave the gall to pupate in the soil. Probably only one generation occurs per year. In Maryland these galls are usually found on *S. nemoralis* in September and

October. Adults emerged in June from larvae collected in autumn the previous year. The cecidomyiid *Youngomyia podophyllae* (Felt) is an inquiline and can be found in galls after the *Schizomyia* larvae have left. Hosts: *S. altissima*, *S. canadensis*, *S. juncea*, *S. leavenworthii*, *S. nemoralis* and *S. fistulosa*. Distr.: Maine to New York, south to Florida. Gagné 1971b.

19b Gall nearly evenly cylindrical, Plate 43 (2c) ..... *Rhopalomyia* sp.

This species is known only from its brown galls that reside in the USNM and is only tentatively identified as a *Rhopalomyia*. Host: *S. canadensis*. Distr.: Maryland.

20a Gall vase-shaped, Plate 43 (2b) ..... *Rhopalomyia anthophila* (Osten Sacken)

Galls are 5-6 mm long, 2-3 mm wide, usually green-walled, but covered with short, white hair. Adults were reared from galls in autumn. Host: S. *altissima*. Distr.: Ontario, Massachusetts, New York, North Carolina and Missouri. Dorchin et al. 2009.

20b Gall onion-shaped, tapered at apex, Plate 43 (1) ..... *Rhopalomyia racemicola* Felt

Galls are 8-9 mm long and 4-5 mm in diameter, green, hairy, sometimes confluent. This species is only tentatively listed here as causing the galls in Plate 43, which came from central Florida. *R. racemicola* was reared in autumn in North Carolina from flower heads with galls apparently similar to these. In Florida, adults emerged in December. Hosts: *S. canadensis*, *S. fistulosa*. Distr.: North Carolina and Florida. Dorchin et al. 2009.

Sonchus (sow-thistle)

Leaf blister ..... *Cystiphora sonchi* (Vallot)

Galls are green or red, their upper leaf surface convex, the lower surface flat. One larva occupies each blister. Fully developed larvae may either pupate in the gall or drop to the soil and form a cocoon. Three generations per year occur in Canada. Females oviposit into stomatal openings of the lower surface of leaves that are still growing but nearing the end of expansion. This species was introduced into Canada from Europe for the control of its weedy host, a rangeland pest. Host: *S. arvensis*. Distr.: Nova Scotia and Manitoba, s. to Minnesota. DeClerck and Steeves 1988, Peschken et al. 1989, Hesler et al. 2020.

Stenotus (goldenweed)

Blister gall on leaf, as on Plate 38 (1) ..... *Asteromyia chrysothamni* Felt

Galls are blue-gray to black, elongate-elliptical, 5-15 mm in diameter, usually only weakly convex and become hard when mature. Several larvae may live in separate chambers in one gall. Host: *S. armerioides*; also *Chrysothamnus* spp. Distr.: western North America. Gagné 1968a.

Symphyotrichum (aster)

As noted earlier, native North American flora previously in *Aster* have now been recombined among several genera, most of them under *Symphyotrichum*. The remainder will be found under *Chloracantha*, *Doellingeria*, *Eurybia*, *Ionactis* and *Sericocarpus*. In addition to the species keyed below, two others were reared from galls that were not described in enough detail to place in a key. They are *Rhopalomyia astericaulis* Felt, reared from an ovoid stem gall on *Symphyotrichum novae-angliae* in Massachusetts and *Rhopalomyia asteriflorae* Felt, reared from abnormally bunched or stunted heads of *Symphyotrichum lanceolatum* (as *Aster paniculatus*) in New York.

1a Tapered stem swelling, Plate 34 (5) ..... *Neolasioptera* spp.

Swellings are usually found on thin, more apical branches, are 10-25 mm long, with one or more larvae that live in a tunnel along the plant's main axis. Larvae overwinter in the galls and adults emerge in late spring. Three species of *Neolasioptera*, not yet critically examined, have been described from such galls. Stem galls have been found from New England and Ontario to North Carolina and Missouri on many more asters than listed for the three original host species and one other that are listed below.

N. albitarsis (Felt). Host: *S. cordifolium*. Distr.: New York.

N. punicei (Brodie). Host: *S. puniceum*. Distr.: Ontario.

N. ramuscula (Beutenmüller). Hosts: *S. dumosum*, *S. patens*. Distr.: North Carolina.

Neolasioptera sp. Host: *S. lateriflorum*. Distr.: Massachusetts. Eiseman 2025a.

1b Leaf, bud, or flower galls 2
2a Leaf galls 3
2b Bud gall or flower gall 4
3a Circular, variably colored leaf blister, Plate 34 (8), or black or purple swelling on twigs, Plate 38 (14) ..... *Asteromyia* spp.

Asteromyia clarkei (Felt) and *A. laeviana* (Felt) form the same kind of galls and have hosts in common. A characteristic fungus is associated with the galls. The fungus eventually develops into a black cast surrounding the larvae. Both gall midge species appear to have several generations per year, beginning on the lower cauline leaves in spring and progressing upward through summer. The blisters are 4-10 mm in diameter. Color varies with the host, those on *S. laevis* are yellow to light gray, those on *S. ericoides*, purple to black. Hosts: *Symphyotrichum* spp. Distr.: throughout North America. Gagné 1968a.

3b Conical, erect gall ..... *Rhopalomyia* sp.

Galls were found at the edge of leaves within leaf clusters. Hosts: *S. novaeangliae*, *S. prenanthoides*. Distr.: Iowa, Ohio, Maryland. See on BugGuide, Eiseman 2025a.

4a Gall a large, gnarly/tuberous apical growth without emergent leaves, see Image 30 .... *Rhopalomyia* sp.

Larvae live in individual chambers. Host: *S. praealtum*. Distr.: Oregon.

4b Gall composed of a rosette of leaves or individually modified buds or flowers 5
5a Gall composed of a rosette of leaves 6
5b Non-leafy bud gall or modified flower or floret 8
6a Catkin-like growth on side branches, longer than broad, with narrow leaf tips along length of gall, Plate 34 (7) ..... *Rhopalomyia strobiligemma* (Stebbins)

Galls are polythalamous. Adults emerged from galls in September. Host: *S. ericoides*, *S. lanceolatum*. Distr.: Massachusetts and New York.

6b Terminal, loose or tightly bunched rosette of modified leaves 7a
7a Loose rosette of wide, short leaves, with single, central larval chamber, Plate 34 (10-11) .... *Asphondylia recondita* (Osten Sacken)

Galls are 10-20 mm long and occur at the tips of branches. The single larval chamber is at the center of the gall. Adults emerge from the gall in summer. Hosts: *S. novae-angliae*, *S. patens*; also *Sericocarpus asteroides*. Distr.: New York to North Carolina.

7b Tightly bunched, polythalamous rosette of short, narrow leaves ..... *Rhopalomyia* sp.

This is possibly the gall caused by *R. asteriflorae* Felt that was reared from "abnormally bunched or stunted heads of *S. paniculatus*" [now *S. lanceolatus*]. Host: *S. cordifolium*. Distr.: Massachusetts. Eiseman 2025a.

8a Gall naked, irregularly conical, Plate 45 (7) ..... *Asphondylia thompsonae* Plakidas

The single-chambered, brownish galls can be found at stem apices in midsummer. Adults emerge before flowering and may cause a later gall on the inflorescence. The overwintering generation forms a crown gall that develops in spring. Hosts: *S. lanceolatum*, *S. subulatum*. Distr.: Pennsylvania, Maine. Plakidas 2016.

8b Gall ovoid, loosely white-haired or conical, fuzzy 9
9a Gall ovoid, white-haired, Plate 34 (6), see Image 31 ..... *Rhopalomyia* spp.

Galls are sessile and widest at base, 4-7 mm long by 3-5 mm in diameter, one-chambered, ovate, pointed at apex and green with white hairs. Adults have been reared from the galls in autumn. The three species listed as responsible are too incompletely known to determine whether they are separate species. In addition to the localities listed below, similar galls have been taken on *S. prenanthoides* in Massachusetts, S. ericoides in Oklahoma and an undetermined species of *Symphyotrichum* in Nebraska.

R. crassulina Cockerell. Host: *S. falcatum* (orig. as *Aster crassulus*). Distr.: Colorado.

R. gemmaria (Stebbins). Host: S. *ericoides*. Distr.: Massachusetts Oklahoma.

R. lateriflorae Felt. Host: *S. lateriflorum*. Distr.: Massachusetts and New York.

9b Gall short-conical, surface obscured by thick, white, fuzzy covering …… *Rhopalomyia* sp.

Host: *S. lanceolatum*. Distr.: Connecticut. Eiseman 2025a.

Taraxacum (dandelion)

Leaf blister …… *Cystiphora taraxaci* (Kieffer)

Galls are green or red, slightly convex above, flat below. One larva occupies each gall. Fully developed larvae either pupate in the gall or drop to the soil and form a cocoon. This species is apparently an accidental introduction into Canada from Europe. Host: *T. officinale*. Distr.: Saskatchewan; Europe. Peschken et al. 1993.

Tetradymia (horsebrush)

Woolly, ovoid, lateral bud gall …… *Dasineura tetradymia* (Felt)

Galls are polythalamous. Adults emerged from galls in April. Host: *T. comosa*. Distr.: California.

Tetraneuris (four-nerve daisy)

Stem swellings …… *Neolasioptera* sp.

Host: *T. scaposa*. Distr.: Texas.

Tripleurospermum (mayweed)

Witches-broom of branches and leaves …… *Rhopalomyia tripleurospermi* Skuhravá

Galls are polythalamous. This species was introduced from Europe into Canada in 2000 to help control its invasive alien host. The overwintering generation lives in galls formed on the basal rosettes and the spring and summer generations live in leaf axils or flowers. Host: *T. perforatum*. Distr.: Prairie Provinces, Canada, apparently established; Europe. Hinz 1998, Skuhravá & Hinz 2000, See on GallFormers.org.

Verbesina (crownbeard)

1a Leaf blister …… *Asteromyia* sp.

This first and only known record of an *Asteromyia* found on a host outside of the tribe

Astereae is considered accidental. On July 10, 2012, I found galls on upper leaves of a specimen of *V. alternifolia* not yet in flower. Repeated visits to the site and searches elsewhere never produced another instance. Galls were black, about 4 mm diameter and could pass for the characteristic galls of *A. carbonifera* on *Solidago juncea*. Each gall contained a single second instar larva. Host: *V. alternifolia*. Distr.: Maryland.

1b Swellings on various plant organs or aborted floret 2
2a Greatly swollen or undeveloped, shriveled floret 3
2b Swollen buds, stems or petioles 4
3a Greatly swollen floret, Plate 45 (6), see Image 32 ..... *Schizomyia verbesinae* (Beutenmüller)

Galls may affect a single floret or several in combination and have a single or several chambers. The red, active larva in each gall drops to the soil when full-grown. Galls were found in mid-October in South Carolina as larvae were exiting. Hosts: *V. alternifolia*, *V. occidentalis, V. virginica*. Distr.: Pennsylvania, North Carolina, South Carolina, Oklahoma.

3b Aborted shriveled floret ..... *Clinodiplosis* sp.

In autumn, full-grown larvae, still nearly fully covered with their second instar exuviae, were found appressed alongside shriveled, aborted achenes in the flower heads. Host: *V. occidentalis*. Distr.: Maryland.

4a Spheroid lateral or apical bud, see Image 33 ..... *Asphondylia* sp.

Galls occur first on lateral buds and subsequently on apical buds and flower heads as the season progresses. Larvae and pupae are found as early as February in Florida but only by July in Maryland. At least two generations occur per season in Maryland, each high on the plant. In Maryland the site of the overwintering generation was not found. Hosts: V. *alternifolia, V. virginica*. Distr.: Maryland, Florida.

4b Swollen stems, petioles or leaf midribs 5
5a Slender, hard and woody stem swelling, larval tunnels oriented along vertical axis, see Image 34 ..... *Neolasioptera imprimata* Gagné

Galls are found in summer and fall. Two generations occur per year. Pupation occurs in the galls. Host: *V. alternifolia*, *V. virginica*. Distr.: Oklahoma and Ohio and Pennsylvania to Georgia. Gagné & Palmer 2019.

5b Ovate stem swelling, at first with a soft interior, the larval tunnels directed haphazardly, Plate 45 (1); also in succulent leaf midrib swelling, see Image 35 … *Neolasioptera verbesinae* Möhn

Galls are larger and more obvious than those of *N. imprimata* and generally soft inside while the larvae are actively feeding. They can be found in mid and late summer along much of the stem, including, later, at the base of the flowering branches. Larvae live in elongate, winding tunnels in the large swellings. Adults from the year's last generation emerge only the following spring from silk-lined tubes covered by hard fungal excrescence. Host: *V.*

alternifolia and *V. occidentalis* in eastern U.S., *Verbesina* spp. in El Salvador. Distr.: Pennsylvania, West Virginia and Maryland, also El Salvador. Gagné & Palmer 2019.

Vernonia (ironweed)

1a Swollen stem, petiole or midrib, see Image 36 …… *Neolasioptera vernoniae* (Beutenmüller)

Swellings are green to red, usually polythalamous. Stem galls can be 5 cm long and 2 cm wide and are soft and pithy at first, turning woody. The discrete larval channels that run in all directions become hard-walled before eventually hardening and turning black from the excrescence of the associated fungus. Hosts: *V. baldwinii*, *V. noveboracensis*. Distr.: New York to Virginia, west to Nebraska and south to Texas.

1b Swollen lateral bud or flower head gall …… 2
2a Swollen lateral bud, see Image 37 …… *Asphondylia vernoniae* Felt

[The gall is] "more or less globular, with uneven longitudinal ribs, resembling nuts, of a dark green color, with the ribs and apex often purplish." The quotation is from notes typed Sept. 21, 1885, by the gall's collector, Thomas Pergande of the USDA, Washington, DC. Larvae of the inquiline *Youngomyia podophyllae* (Felt) have been found in this gall. Host: *V. noveboracensis* and possibly also *V. blodgettii*. Distr.: West Virginia, Virginia and Florida.

2b Modified flower heads …… 3
3a Swollen pedicel, hidden from exterior view, see Image 38 …… *Neolasioptera* sp.

When larvae are numerous, the base of the flower heads becomes swollen. Full-grown larvae form a cocoon in place. Host: *V. noveboracensis*. Distr.: West Virginia, Maryland.

3b Swollen, aborted floret …… *Schizomyia vernoniae* Plakidas

Affected flowers are only slightly larger than unaffected ones. The active red-orange larvae leave the galls in early September. Host: *V. noveboracensis*. Distr.: Pennsylvania.

Xanthium (cockleburr)

1a Larva in root …… *Resseliella radicis* (Felt)

Damage or symptoms were not specified further. Host: *Xanthium* sp. Distr.: Alabama.

1b Branch tip galls …… *Asphondylia xanthii* Felt

The galls were not specified further. Adults were reared in June. Host: *X. strumarium*. Distr.: Texas.

Xanthocephalum (see *Gutierrezia*).

Xylorhiza

Elliptical, black, blister leaf gall …… unidentified alycauline, possibly *Neolasioptera* sp.

Galls were found in early March and adults emerged the following day. Host: *X. orcuttii*. Distr.: California. Eiseman 2025a.

Balsaminaceae

Impatiens (jewelweed)

1a Spherical, pendent flower bud gall, Plate 46 (1a) …… *Schizomyia impatientis* (Osten Sacken)

Galls are succulent and 10-15 mm in diameter. The red, active larvae leave the galls in late summer or early fall and overwinter in the duff. Larvae of the inquilinous *Youngomyia podophyllae* (Felt) are occasionally found in these galls. Hosts: *I. capensis*, *I. pallida*. Distr.: Maine to Virginia.

1b Swollen leaf vein, petiole, or stem …… 2
2a Swollen midrib or petiole, Plate 46 (1b) …… *Neolasioptera impatientifolia* (Felt)

Swellings are succulent, light green, partly translucent and usually more visible from beneath the leaves. Each contains one to several larvae and a fungal associate. At least two generations occur per year. Pupation occurs in the galls. Larvae of *Youngomyia podophyllae* (Felt) may sometimes be found in the galls. Hosts: *I. capensis*, *I. pallida*. Distr.: Maine to Virginia.

2b Swollen stem base …… *Lasioptera centerensis* Felt

Known only from a larva, this species was reported once, from a "double-celled" gall. Host: *I. pallida*. Distr.: New York.

Betulaceae

Alnus (alder)

1a Folded leaf …… *Dasineura* sp.

Young leaves are folded in half on the long axis. Full-grown larvae spin cocoons in the folds where they pupate. Host: *A. rubra*. Distr.: British Columbia to California. Russo (2021).

1b Enlarged, deformed bud or catkin …… 2
2a Enlarged bud, Plate 46 (2) …… *Dasineura serrulatae* (Osten Sacken)

Affected buds are 6-12 mm in diameter. Each contains several reddish larvae that drop to the soil in autumn. Adults emerge in spring. Hosts: *A. crispa*, *A. rugosa*, *A. serrulata*. Distr.: Massachusetts and Ontario to North Carolina.

2b Deformed male catkin (see Plate 46 (6) for *Corylus*) ..... *Dasineura* sp.

Usually only a part of the catkin is affected and covers many interconnected larval chambers. Galls are apparent in late summer. Adults emerge in early autumn. Host: *A. rubra*. Distr.: California. Russo 2021.

Betula (birch)

1a Swollen stem, bud, or base of petiole, Plate 46 (3) ..... *Massalongia papyriferae* (Gagné)

Galls appear in midsummer. Full-grown larvae drop to the ground in late September and form cocoons in which they overwinter. Adults emerge in mid-May and lay eggs at the base of leaves on new terminals. Several larvae occur in separate chambers in the cortical enlargement. Bud and stem mortality results from girdling. Host: *B. papyrifera*. Distr.: Quebec, Michigan, Washington and Oregon. Wilson 1968d.

1b Swollen bract or seed of female catkin ..... *Semudobia* spp.

Five species of *Semudobia* are known from North America, three of them native, the other two introductions from Europe with seeds or bracts of the ornamental *Betula pendula*. Of the three native species, one is Holarctic, the other two Nearctic only. The biology of all five species is generally similar. Eggs are deposited in spring between bracts and flowers. A single larva usually infests a bract or ovary. Pupation occurs in the gall the following spring. Roskam 1977, Roskam and Van Uffelen 1981.

The five species in our region are:
S. betulae (Winnertz), an immigrant from Europe. Host: *B. pendula*. Distr.: Ontario and Pennsylvania.
S. brevipalpis Roskam, an eastern Nearctic species. Hosts: *B. papyrifera* and *B. populifolia*. Distr.: Quebec and Ontario, south to Maryland.
S. skuhravae Roskam, a Holarctic species. Hosts: *B. alleghaniensis*, *B. occidentalis*, *B. papyrifera*, *B. pendula* and *B. populifolia*. Distr.: Connecticut and South Dakota to Alberta, south to Colorado.
S. steenisi Roskam, a western Nearctic species. Hosts: *B. occidentalis*, *B. papyrifera*. Distr.: Montana to British Columbia, south to Colorado.
S. tarda Roskam, an immigrant from Europe. Host: *B. pendula*. Distr.: Quebec, Montana and Idaho.

Carpinus (hornbeam)

Fold along leaf vein, Plate 46 (5) ..... *Dasineura pudibunda* (Osten Sacken)

Galls appear by May 10 in the mid-Atlantic region as an infolding of the lower side of the lateral veins and eventually appear more prominent on the upper side of the leaf where they usually turn red. The folds become hard and brittle while the larvae are still in the first instar. One to several larvae live in each fold. Larvae develop very slowly and the third instars drop to the soil in late summer. Host: *C. caroliniana*. Distr.: Massachusetts and Ontario to Virginia.

Corylus (hazel)

1a Folded or swollen leaf veins at base of leaf, see Image 39 …… *Clinodiplosis corylifolia* (Felt)

Leaf swellings are covered with red crinkled hair. Available affected leaves contained gregarious, yellow, unidentified second instar larvae. *Ledomyia coryli* (Felt) was originally reared from similar galls, but its larvae are presumably secondary feeders. Hosts: *C. americana*; also *Nyssa sylvatica* (Nyssaceae). Distr.: Minnesota, New York.

1b Enlarged bud, deformed catkin, or larvae atop base of fruit …… 2
2a Enlarged, aborted bud …… *Contarinia* sp. and *Dasineura* sp.

The Felt collection contains larvae of each of these genera from bud galls found in New York, but which or whether both of them cause the gall is unknown. Adults have not been reared. Hosts: *C. americana, C. cornuta*. Distr.: California, New York, Maryland, Virginia. Russo 2021.

2b Deformed catkin or larvae free atop base of fruit …… 3
3a Deformed catkin, Plate 46 (6) …… *Contarinia squamulicola* (Stebbins)

Infested catkins are usually deformed at their base where larvae can be found nestled inside the swellings. Mature larvae drop to the ground in late summer. Larvae of *Clinodiplosis* sp. and *Lestodiplosis* sp. have also been found among the enlarged bracts. The *Clinodiplosis* larvae appear to be associated with necrotic tissue. Host: *C. americana*. Distr.: Massachusetts to West Virginia and Maryland.

3b Larvae atop base of nut, see Image 40 …… cecidomyiid

Unidentified yellow larvae were found atop the nut in summer. It is possible they emerged from the nut. Host: *C. cornuta*. Distr.: Minnesota.

Ostrya (hop-hornbeam)

Folded leaves, as on Plate 46 (5) …… *Dasineura* sp.

The larva on which this record (Felt 1940, 1965) is based is an unidentifiable second instar, but the gall is similar to that on *Carpinus* formed by *Dasineura pudibunda*. Host: *O. virginiana*. Distr.: New York, Maryland.

Bignoniaceae

Campsis (campsis, trumpet creeper)

1a Larva in leaf curl or marginal roll …… *Contarinia tecomae* (Felt)

Full-grown larvae make transparent silken cocoons in situ and pupate there. This species has several generations per year. Adults emerge from the current year's galls as early as late May in Maryland. Host.: *C. radicans*. Distr.: New York, Maryland. Einem 1993.

1b Larva in flowers or pods …… 2
2a Larva in flowers …… *Contarinia* sp., *Hyperdiplosis spiraeaflorae* (Felt) and *Prodiplosis* sp.

Contarinia sp. Adults are active at night and can be seen with the aid of infrared light resting on anthers or on the corolla near the anthers (Einem 1993). Adults can also be seen on flower buds. Larvae live near the base of the ovary where they crawl about in the nectar. They were recovered also from aborted flowers and flower buds that dropped to the ground. Several generations may occur per year. The same or a related species of Contarinia inhabits the flowers of catalpa. Host: *C. radicans*. Distr.: Maryland. Einem 1993.

H. spiraeaflorae. Adults were reared in late July from larvae taken in flowers two weeks earlier. It is presumably a secondary feeder; it has also been associated with spirea and wheat. Host: *C. radicans*. Distr.: New York, Maryland.

Prodiplosis sp. Adults and larvae were observed in the same niches as the *Contarinia* sp. noted above, and adults of both emerged from the same flowers. The same species of *Prodiplosis* was observed at flowers and nectaries in Kansas. Host: *C. radicans*. Distr.: Kansas, Oklahoma, Maryland. Einem 1993.

2b Larva in pods …… *Contarinia* sp.

Larvae are gregarious and similar to those of *Contarinia catalpae* on *Catalpa*. Full-grown larvae were collected in mid-September and adults emerged the following April. Host: *C. radicans*. Distr.: Oklahoma

Catalpa (catalpa)

1a Larva in pod, bud, or flower …… 2
1b Larva in or on leaf …… 4
2a Larva in pod …… *Contarinia catalpae* (Comstock)

The Catalpa gall midge. Infested pods contain many gregarious larvae. Pods often show small, circular holes, probably made by another insect, possibly a weevil. The holes may be necessary to allow the gall midge female to initially insert her eggs into the pods. The tissue around the larvae turns brown before the full-grown larvae escape the pods through the

existing holes. Host: *C. bignonioides*, possibly *C. speciosa*. Distr.: Indiana to Maryland. Gossard 1908.

2b Larva in bud or flower …… 3
3a Larva in bud …… cecidomyiid

In early summer new shoots become swollen and contain gregarious larvae. Full-grown larvae drop to the ground, after which the shoots turn brown and die. Host: *C. bignonioides*. Distr.: Ohio. Gossard 1908.

3b Larva in flower …… *Contarinia* spp.

Two species have been found in the corollas, *Contarinia catalpae* (Comstock) (see entry 2a of this key), which also infests pods, and another, unidentified species of *Contarinia*. The latter is distinct and evidently closely related to the one found in flowers of trumpet creeper. Larvae of the latter did not pupate soon after dropping to the soil, so this species may have only one generation per year. The similar species on trumpet creeper has at least two generations, possibly connected to the fact that flowers of that plant bloom throughout the summer. Host: *C. bignonioides*. Distr.: Maryland, Ohio and Kansas.

4a Discolored, circular leaf spot …… *Neolasioptera* sp.

Spots are about 5 mm in diameter and can be found from May to November. Reportedly, they may occur in such large numbers as to cause the leaf to wilt. Some larvae drop to the ground to pupate, others pupate in the leaf. Adults were reared in spring from galls collected in November. Host: *C. bignonioides*. Distr.: Pennsylvania, Maryland and Ohio. Gossard 1908.

4b Curled midrib of leaf …… cecidomyiid

No further details of this damage were reported (Maze 1949). Host: *C. bignonioides*. Distr.: Pennsylvania.

Chilopsis (desert willow)

Larva in flower buds …… *Contarinia* sp.

Adults were reared in spring. Host: *C. linearis*. Distr.: Oklahoma, Texas.

Boraginaceae

Amsinckia (fiddleneck)

Spherical, soft swellings on inflorescence, stem, or leaf …… *Schizomyia macrofila* (Felt)

Adults emerge in spring and lay eggs directly into plant tissue. Galls are 3-15 mm in diameter. One to six larvae develop swiftly in the center of each gall and drop to the soil when full-grown. One generation occurs per year. Hosts: *A. lycopsoides*, *A. menziesii*, *A. spectabilis*. Distr.: California. Pantone and Brown 1985, Pantone et al. 1985.

Eriodictyon (yerba santa)

Flower bud galls, See Image 41 ..... *Asphondylia* sp.

Affected flower buds are enlarged and covered with long white hairs. Hosts: *Eriodictyon californica*, *E. trichocalyx*, *E. traskiae*. Distr. California.

Heliotropium (heliotrope)

Stem swellings, See Image 42 ..... *Neolasioptera* sp.

Swellings are variable, often knobby and the same color as the stem. Gregarious, orange larvae live inside a large, central chamber mostly lined with a white fungal mycelium. Pupation occurs inside the gall and adults escape through one or more openings at the sides or near the gall apex. Host: *H. curassavicum*. Distr.: California.

Hydrophyllum (waterleaf)

In leaf petioles ..... *Neolasioptera* sp.

Affected petioles show blackening as the season progresses. Larvae live along the pith. Hosts: *H. appendiculatum*, *H. virginianum*. Distr.: Iowa. See on BugGuide.

Lithospermum (stoneseed)

Spheroid, hollow branch tip ..... *Neolasioptera* sp.

Galls are gray to light green and appear to be formed by closely juxtaposed swollen bases of two leaves. The gregarious orange larvae live in the interior space where they remain until the following spring. Hosts: *L. canescens*, *L. incisum*. Distr.: Wisconsin, Minnesota, Iowa, Oklahoma. See on BugGuide.

Mertensia (bluebells)

In closed, succulent, thick-petaled, aborted flowers ..... cecidomyiid

Larvae are orange. Host: *Mertensia* sp. Distr.: Washington.

Nemophila (baby blue eyes)

Gnarled, improperly developed flowers ..... cecidomyiid

Larvae are white and gregarious. They appear to belong to *Contarinia* in the broad sense. Host: *N. menziesii*. Distr.: Sonoma Co., California.

Brassicaceae

Boecheria (rockcress)

Root gall …… cecidomyiid

Galls simulate nitrogen-fixing nodules of legumes. Each gall encloses an orange-brown larva that belongs to the supertribe Lasiopteridi. Host: *B. puberula*. Distr.: Oregon.

Brassica (mustard)

Deformed stalks and crumpled leaves …… *Contarinia nasturtii* Kieffer

Eggs are laid on new growth or leaf stalks. Subsequent deformation may occur on stems, leaves and flowers. Larvae cause disruption of growth at the terminals where the vegetative heads normally form. Three to five overlapping generations occur per year. This European species is a recent accidental introduction into North America. Its common name in the United Kingdom is swede midge. Host: *Brassica oleracea* (cole crops generally, including broccoli and cauliflower). Distribution: Ontario, Quebec, New York, New Hampshire to New Jersey, west to Minnesota, and Europe. Hallett & Heal 2001, Corlay & Boivin 2008.

Cardamine (watercress)

Deformed, irregularly conical flowers …… *Dasineura* sp.

This damage was noted in Felt (1940, 1965). Damaged flowers measured about 1 cm long. Host: *Cardamine* sp. Distr.: unspecified.

Erysimum (wallflower)

1a Larva free in flowers …… *Dasineura* sp. and *Prodiplosis* sp.

Adults of both species were reared in spring from unspecified damage. Host: *E. menziesii*. Distr.: California.

1b Larvae in swollen, elongated siliques …… *Asphondylia* sp.

Adults were reared in summer. See the *Nasturtium* entry also. Host: *E. linifolia*. Distr.: Arizona.

Lepidium (pepperweed)

1a Swollen silique ..... *Dasineura lepidii* Felt

Infested siliques are darker than normal. Adults were reared in mid-July. Host: *L. virginicum*. Distr.: Maryland.

1b Stem or root swelling ..... cecidomyiid

The only reference to this species is in Felt (1940, 1965) as *Cecidomyia* sp. Host: *Lepidium* sp. Distr.: unspecified.

Nasturtium

Swollen flower ..... *Asphondylia* sp.

Adults were reared in June. An *Asphondylia* sp. is also known from *Erysimum* (q.v.), also in Arizona. Both that host and *Nasturtium* are native to Europe, so the unidentified insect may also be European. *Asphondylia stefanii* Kieffer from Sicily is the only European *Asphondylia* known on Brassicaceae, specifically from siliques of *Diplotaxis tenuifolia*, but that gall midge, not reported since it was described by Kieffer, will have to be found again before comparisons can be made. Host: *Nasturtium* sp. Distr.: Arizona.

Sisymbrium (hedge mustard)

Swollen bud ..... cecidomyiid

Felt (1918a) questionably referred this record to the European *Dasineura sisymbrii* (Schrank). Felt's specimen is a larva of a *Lestodiplosis*, a predaceous cecidomyiid, so the cause of the swelling remains unknown. All *Sisymbrium* species in North America are introduced, so a gall on one of them could be caused by an immigrant cecidomyiid. Host: *Sisymbrium* sp. Distr.: unspecified.

Stanleya (prince's plume)

Swollen flower ..... *Dasineura stanleyae* (Cockerell)

Sepals of infested flowers are thickened and enlarged. Larvae are gregarious. Host: *S. pinnata*. Distr.: Colorado.

Bromeliaceae

Tillandsia (airplant)

Root nodule, See Image 43 ..... *Neolasioptera* sp.

Plants with such galls are often intercepted at United States ports of entry. Nodules resemble those also seen on rootlets of orchids. Hosts: *Tillandsia* spp. Distr.: Mexico and south through tropical South America.

Buxaceae

Buxus (boxwood)

Leaf blister, Plate 46 (4) ..... *Monarthropalpus flavus* (Schrank)

Boxwood leafminer. Slight blisters, often chlorotic, about 5 mm at greatest diameter, appear on the upper side of the leaf. One or occasionally two or more yellow-green larvae live in each chamber surrounded peripherally by a ring of succulent mesophyll tissue. Larvae are in the early last instar at the onset of winter, grow additionally in early spring, pupate in situ and emerge in swarms on a humid morning in spring. Affected leaves die soon after, giving a seriously infested plant a sickly appearance. Eggs are laid on leaf primordia in fresh buds. One generation occurs in Maryland per year, but in France this species has both univoltine and bivoltine races (Baylac 1989). An immigrant from Europe, it was introduced with its host into North America during colonial times. Hosts: *B. microphylla*, *B. sempervirens*. Distr.: New York and southern New England to Virginia and Michigan and California. Smith and Fisher 1930, Valley 1981, Brewer et al. 1984.

Cactaceae

Opuntia (pricklypear)

1a Swollen fruit ..... *Asphondylia betheli* (Cockerell) and *Contarinia* sp.

A. betheli. Adults emerge from fruit in early spring and lay eggs on the rapidly developing flower buds. Buds begin to develop normally, but several weeks later turn yellowish. Seeds fail to develop and infested fruit persist on the plant longer than uninfested fruit. Larvae grow slowly at first, more quickly in early winter, and pupate in the galls in early spring. The aborted fruit shrivel and drop off after the adults exit. Occasionally the decaying fruit become infested with a secondary, gregarious but mycophagous cecidomyiid, *Asynapta cactophila* Samuelson. Hosts: *O. macrorhiza*, *Opuntia* spp. Distr.: Colorado to California, south throughout Mexico. Ganz 1968, Mann 1969.

Contarinia sp. The USNM has a series of a *Contarinia* sp. from Mexico taken from fruit intercepted at the Laredo, Texas, port of entry. It is distinct from *Contarinia opuntiae* (see below). Host: *Opuntia* sp. Distr.: Mexico.

1b Swelling or necrotic area on segment (pad) 2
2a Larva from dead tissue at base of spine ..... *Contarinia opuntiae* (Felt)

This species was originally found on plants at the New York Botanical Garden and since then in Texas and Mexico (unspecified). Nothing else is known of its biology. Hosts: *Opuntia* spp. Distr.: Texas and Mexico.

2b Larva in slight swelling of segment (pad), affected area sometimes yellow … …… *Neolasioptera* sp. and cecidomyiid

Neolasioptera sp. Many red larvae of this species were found in chambers about 1 cm in diameter. They spun cocoons when full-grown, pupated in the galls, and adults emerged in March. Hosts: *O. englemannii*, *Opuntia* sp. Distr.: Aguascalientes. Mann 1969.

Cecidomyiid. Three separate species were briefly mentioned in Mann (1969) and tentatively but presumably erroneously identified as belonging to *Mayetiola*. The relevant specimens appear to be lost. The three are: orange larvae on *O. lindheimeri* in Texas; orange larvae on *O. tomentosa* from Morelos and larvae of unspecified color from *O. tomentosa* near Mexico City. Mann 1969.

Campanulaceae

Lobelia (lobelia)

Stem and midrib swellings, Plate 80 (7) …… *Neolasioptera* sp.

Specimens from the North Carolina record were not preserved and are only tentatively referred to *Neolasioptera*. Host: *L. puberula*, L. siphilitica. Distr.: Iowa, North Carolina. Wells 1921a.

Cannabaceae

Celtis (hackberry)

Most cecidomyiids from hackberries belong to *Celticecis*. Twenty-one species of the genus are known from North America east of the 100th Meridian. Some are restricted within that range, with the greatest number occuring in Florida and southcentral United States. They form complex, monothalamous, easily detachable leaf and twig galls. Galls of most develop in spring, a few in summer, but all eventually drop to the ground in late summer. All except those of one species enclose a single larva; only *Celticecis connata* Gagné forms an aggregate gall, but its larvae are still segregated in separate chambers. All pupate inside their galls the following spring.

Immature galls of many species often appear alike because they first grow lengthwise before broadening to their ultimate shape, so it is best to have fully formed galls to use with the key that follows. Pristine cecidomyiid galls have no frass, wax or other detritus and the larvae are legless with small but definite head capsules tipped with short antennae. These features will separate them from the many other gall makers of buds, stems and leaves of hackberry that are formed mostly by Psyllidae (Hemiptera), but also by Eriophyidae (Acarina) and Agromyzidae (Diptera).

Individual *Celtis* hosts are not given for each species in this key because the gall midges on hackberries do not appear to be strictly host specific. For this key as well as the illustrations, *Celticecis* galls are oriented with their apex upwards without regard to which leaf surface they occur on. For further information on the gall midges in this key, see the revision in Gagné & Moser (2013). See Mapes & Brown (2018) for additional, subsequent, northeastern United States collection records.

The cecidomyiid *Parallelodiplosis acernea* (Felt) is commonly found in galls of both cecidomyiids and psyllids in eastern North America. It is a fatal inquiline to both groups of insects on *Celtis* and appears to be restricted to hackberries. It is not mentioned in the key below, but further details can be found in Gagné & Moser (2013).

1a Elongate swelling of twig 2
1b Complex galls on twigs and leaves or simple swelling on leaf lamina 3
2a Woody, mostly solid swelling in otherwise healthy stem ... . *Neolasioptera celtis* Möhn.

This gall was recorded only as *Lasioptera* sp. with no locality specified in Felt (1940, 1965). The swelling should be woody and solid except for the elongate larval chambers. The larvae inside should be present throughout the growing season and winter. *Neolasioptera celtis* Möhn has been reported in similar stem swellings of *Celtis iguanaea* in El Salvador (Möhn 1964). It is not known if that is the same item reported by Felt, but integral twig swellings were never encountered by Gagné and Moser in their 2013 study on *Celtis* in the United States. Host: *C. iguanea*. Distr.: El Salvador.

2b Hollow twig swelling, See Image 44 .... *Melanagromyza deserta* (Patton) (Diptera: Agromyzidae)

The gall was once considered to be made by a cecidomyiid (Felt 1940, 1965) but it is caused instead by an agromyzid. Galls and larvae develop rapidly in spring on the lengthening new twigs. Larvae desert the galls as soon as they are full-grown (approximately the second week of May in West Virginia). Host: *C. occidentalis*. Distr.: northeastern United States. Tschirnhaus 2017.

3a Nondehiscent galls 4
3a Dehiscent galls (*Celticecis* spp.) 5
4a Convex, hairless leaf swelling on upper leaf surface, a cylindrical chimney below, hackberry blister gall; southeastern United States, Plate 56 ..... *Peracecis fugitiva* Gagné

Hosts: *C. tenuifolia*, *C. laevigata*, *C. occidentalis*. Distr.: Kansas, Texas, Louisiana and Georgia.

4b Various hairy or naked leaf or twig galls containing psyllids, Plate 47 (1j) .... *Pachypsylla* spp. (Hemiptera: Psyllidae; not keyed further)
5a Gall on leaf, usually on underside and seldom causing distortion 6
5b Gall on twig, bud, fruit, occasionally on leaf surface and then usually causing leaf distortion 20
6a Gall attached to leaf lamina between veins 7

6b Gall attached to vein 15
7a Gall surface naked 8
7b Gall surface hairy 12
8a Gall apex rounded, gall less than 2 mm long, hackberry barrel gall; Texas and Louisiana, Plate 50 (6) ..... *Celticecis cupiformis* Gagné
8b Gall apex pointed, gall more than 2.5 mm long 9
9a Gall abruptly narrowed near apex, hackberry aciculate gall; southern United States east of 100th Meridian, Plates 48 (1-2), 54 (4) ..... *Celticecis aciculata* Gagné
9b Gall gradually tapered to apex 10
10a Gall base strongly flared outwards, hackberry thorn gall, widespread eastern United States except Florida, Plates 47 (1e), 48 (2), 54 (3-5) ..... *Celticecis spiniformis* (Patton)
10b Gall evenly conical, gradually tapered from base to apex 11
11a Gall barely longer than wide, less than 3 mm long, hackberry jellybean gall; central and southeastern United States, Plate 49 (5-6) ..... *Celticecis conica* Gagné
11b Gall at least 5 times longer than wide, at least 5 mm long, hackberry awl-shaped gall; southeastern United States, Plates 47 (1h), 48 (2), 54 (6), 55 (1) ... *Celticecis subulata* Gagné
12a Gall flat, circular, sides deeply sulcate, hackberry rosette gall; southeastern United States, Plates 47 (1f), 48 (5-6), 54 (4) ..... *Celticecis capsularis* (Patton)
12b Gall upright, sides not sulcate 13
13a Gall barrel-shaped, less than 2 mm high, brown, with sparse hair, hackberry barrel gall; Texas and Louisiana, Plate 50 (6) ..... *Celticecis cupiformis* Gagné
13b Gall conical or acuminate, more than 5 mm high, green, thickly haired 14
14a Gall bulbous at base, acuminate towards rounded apex, hackberry narrow-tipped gall, Plate 48 (3-4) ..... *Celticecis acuminata* Gagné
14b Gall evenly conical, hackberry fuzzy cone gall; Kentucky, Plate 52 (4) ..... *Celticecis pilosa* Gagné
15a Gall situated in fork of major veins 16
15b Gall situated along any vein 17
16a Gall cylindrical, hackberry pubescent gall; southeastern United States, Plates 47 (1g), 52 (5-6) ..... *Celticecis pubescens* (Patton)
16b Gall turbinate, hackberry top-shaped gall; midwestern United States south to Georgia, Plates 47 (1a), 55 (5-6) ..... *Celticecis wellsi* (Wells)
17 Gall situated atop vein on persistent pad, hackberry horn gall, Plate 50 (4-5) ..... *Celticecis cornuata* Gagné
17b Gall attached directly to vein, usually to one side, without intervening pad 18
18a Gall elongate-conical, supine, hackberry recumbent gall, Plate 55 (2-4) ..... *Celticecis supina* Gagné
18b Gall cylindrical or bulbous, usually upright 19
19a Gall irregularly cylindrical, hackberry pear-shaped gall; midwestern and central Atlantic United States, Plate 53 (1-2) ..... *Celticecis pyriformis* Gagné
19b Gall spheroidal, hackberry globular leaf gall, Plates 51 (4-5), 54 (4) ... *Celticecis globosa* Gagné
20a Gall surface hairy 21
20b Gall surface naked 23
21a Gall evenly spherical with barely evident attenuated apex, hackberry spherical stem gall, Plates 47 (1d), 52 (1-3) ..... *Celticecis oviformis* (Patton)
21b Gall cylindrical or ovate with long attenuate apex 22

22a Gall cylindrical, widest immediately below short, narrow, pointed apex, hackberry acorn-shaped gall, Plates 47 (1b), 49 (1-4) ..... *Celticecis celtiphyllia* (Felt)
22b Gall ovate with gradually attenuate apex, hackberry tenpin gall, Plate 51 (6) .... *Celticecis ovata* Gagné
23a Gall deeply sulcate, with 4 or more vertical winglike extensions, hackberry winged gall; Kansas and Missouri south to Texas and Louisiana, Plates 47 (1i), 53 (6), 54 (1-2) .... *Celticecis semenrumicis* (Patton)
23b Gall cylindrical or spheroid, sides not sulcate 24
24a Gall spheroid, usually comprising two to many separate larval chambers, hackberry aggregate gall, Plate 50 (1-3), 53 (5) ..... *Celticecis connata* Gagné
24b Gall cylindrical, may be closely adjacent to one another but rarely completely joined 25
25a Gall regularly cylindrical with abruptly attenuate apex, entire gall eventually separating from stem or leaf, hackberry columnar stem gall; southcentral United States, Plate 53 (3-5) .... *Celticecis ramicola* Gagné
25b Gall irregularly cylindrical, tapering from wide base, the base integral with stem or leaf; only inner core containing larval chamber eventually dehiscing, hackberry popout gall, Plate 51 (1-3) ..... *Celticecis expulsa* Gagné

Humulus (hop)

Swollen stem ..... *Lasioptera humulicaulis* Felt

The host is Eurasian, so the insect possibly is also, although no *Lasioptera* on hop has been recorded except from Noth America. Larvae are orange and overwinter in the stems. Adults emerge in spring. Host: *H. lupulus*. Distr.: New York.

Caprifoliaceae

Diervilla (bush honeysuckle)

1a Enlarged, deformed bud or fruit ..... *Asphondylia diervillae* Felt

Galls are about 9 mm long and 3 mm at greatest diameter, green, the slender tips discolored. Most are larger on one side, causing the buds to bend in the opposite direction and become sickle shaped. Adults emerged in May and June. Galls from Iowa were apparently secondarily infested by eurytomid wasps (Hymenoptera). Host: *D. lonicera*. Distr.: New York, Iowa, Minnesota. See on BugGuide.

1b From stems ..... *Neolasioptera caulicola* (Felt)

Adults were reared in June from stems showing no apparent enlargement. The pale-yellow larvae reportedly live in individual chambers just under the bark. Host: *D. lonicera*. Distr.: New York.

Lonicera (honeysuckle)

1a Larva in stem internode, its presence inconspicuous …… *Neolasioptera* sp.

Larvae live singly or end to end inside internodes, which may turn black when larvae are mature. Full-grown larvae form a silken cocoon. Host: *Lonicera* sp., either *L. dioica* or *L. reticulata*. Distr.: Iowa. See on BugGuide.

1a Succulent or leafy galls …… 2
2a Succulent, tight cluster of infolded terminal leaves …… *Dasineura* sp.

Galls are red or green, with a sparse coat of short white hair. Gregarious larvae live in chambers formed by the infolded, thickened leaves that make up the gall. Host: *L. involucrata*. Distr.: Washington, Oregon. Russo 2021.

2b Rosette galls …… 3
3a Globular, succulent gall with short bracts emerging from its surface, Plate 46 (7) …… …… *Lonicerae lonicera* Felt

Galls are succulent, smooth, 10-15 mm in diameter and monothalamous. The bud scales surrounding the upper half are usually flared outward. Host: *L. subspicata*. Distr.: California. Ballou 1925, Gagné 2016c, Russo 2021.

3b Leafy rosette galls with large basal bracts …… 4
4a Rosette leaves linear, with white hairs along leaf edges and clustered in the center of each rosette …… *Lonicerae russoi* Gagné

Galls usually appear several together at the tips of shoots but may occur singly also. Individual galls may be 10 mm high by 8 mm in diameter. Leaves or bracts covering the galls are about 3 mm wide. White hair protrudes from edges of the bracts and more densely from the center of each rosette. Galls are monothalamous. Larvae were pupating in late February when the galls were found; adults emerged in late February to early March. Host: *L. hispidula*. Distr.: California. Gagné 2016c, Russo 2021, Eiseman 2025a.

4b Rosette leaves broad, ca 7 mm wide, without white hairs …… *Lonicerae* sp.

Galls are green and lack the white hair seen on galls of *L. russoi*. Several galls may be found at the tip of some shoots but may occur singly also. Individual galls are 10 mm high by 8 mm in diameter. Galls are monothalamous. Larvae pupate in January and adults emerge a short time later. Host: *L. subspicata*. Distr.: California. Russo 2021.

Symphoricarpos (snowberry)

1a Swollen twig …… cecidomyiid

Mention of this gall appears in Felt (1918a, 1940, 1965) as made by a "*Cecidomyia* sp." Host: *Symphoricarpos* sp. Distr.: western United States.

1b Leaf or bud galls …… 2
2a Rolled, thickened and hard leaf margin …… *Dasineura* sp.

Galls appear in May and are 2-3 mm in diameter by 20 mm long, glossy, green to reddish purple and hard. Larvae are orange and gregarious and drop to the ground to pupate. Larvae were full-grown in July and adults were reared from them in August. Some larvae were still in the galls in October, so either emergence is staggered or more than one generation occurs per year. Host: *S. albus*. Distr.: British Columbia to California. Russo 2021

2b Bud galls …… 3
3a Irregularly thickened, partly unfolded opposite leaflets …… *Resselliella californica* (Felt)

This species was based on two females reared from a gall that might fit that of the sawfly, *Blennogeneris spissipes* (Cresson) (Hymenoptera: Tenthredinidae) (cf. Russo 2021). It is possible that the cecidomyiid was a secondary inhabitant. Host: *S. albus*. Distr.: California.

3b Leafy apical or succulent basal stem galls …… 4
4a Leafy apical bud gall …… *Chiosperma turgidum* Gagné

The gall consists of a chamber enclosed by modified leaves. Smaller, bractlike leaves may further surround the base. According to D. Kinateder (in litt.) adults were reared from buds in mid-April in eastern Washington very shortly after the spring flush of growth. Shortly afterwards, females deposited eggs on axial buds. The larva possibly overwinters as a young instar. Host. *S. albus*. Distr.: Washington. Gagné 2016c.

4b Succulent basal stem galls …… possibly *Lonicerae* sp.

These large galls, up 2 cm in diameter, single or clustered on stems just below the soil surface, were found in early July. Galls have 1-6 chambers with a single larva in each. Larvae formed leathery cocoons inside the galls. Emergence presumably occurs in spring. Host. *S. albus*. Distr.: Washington. Russo 2021.

Caryophyllaceae

Cardionema (sandcarpet)

Inside flower tissue …… cecidomyiid

The damage within the flower was not specified. Host: *C. ramosissimum*. Distr.: California.

Celastraceae

Celastrus (bittersweet)

Irregularly swollen root or stem ..... *Neolasioptera fontagrensis* (Gagné)

Galls can be as large as 2.5 cm long and 1 cm in diameter. Larvae overwinter in the gall. Adults have not been reared. Host: *C. scandens*. Distr.: Massachusetts and New York.

Hippocratea (medicine vine)

Irregular root swelling, Plate 77 (3) ..... *Neolasioptera* sp.

Swellings may contain several larvae. Adults have not been reared. Host: *H. volubilis*. Distr.: Florida.

Stellaria (chickweed)

In leafy, aborted apical bud ..... *Dasineura* sp.

Larvae are gregarious within the confines of the gall. Host: *S. aquatica*. Distr.: Iowa. See on BugGuide.

Paxistima (paxistima)

Folded, red, terminal leaves ..... *Dasineura* sp.

Originally reported only as *Cecidomyia* sp. in Felt (1940, 1965), it is is presumably the *Dasineura* reared subsequently. Host: *P. myrsinites*. Distr.: western United States (unspecified) and British Columbia.

Chrysobalanaceae

Geobalanus (licania)

Spheroidal, woody subterranean stem gall, Plate 86 (4) ..... *Lopesia licaniae* Gagné

Galls 3-4 mm in diameter are found 1-10 cm below the soil surface and may be clustered. Each contains a single larva. Pupation occurs in the galls. The pupa is noteworthy for its prominent dorsal abdominal spines, presumably used in exiting the stem and pushing through the soil prior to adult emergence. Host: *G. oblongifolius*. Distr.: Florida. Gagné and Hibbard 1996.

Cleomaceae

Cleomella (Rocky Mountain beeplant, spiderflower)

Enlarged or deformed seed pod …… *Contarinia peritomatis* (Cockerell)

Orange larvae live gregariously in the pods. They probably drop to the soil when full-grown. Adults have not been reared. Host: *C. serrulata*. Distr.: New Mexico.

Colchicaceae

Uvularia (bellwort)

Leaf spot …… *Meunieriella* sp.

This gall was originally attributed to *Ledomyia crispata* (Felt) that came from a container with leaves of this host (Felt 1915a), but larvae and adults collected more recently belong to *Meunieriella*. Host: *U. sessilifolia*. Distr.: Massachusetts and Maryland.

Convolvulaceae

Calystegia (false bindweed)

Tapered stem swelling …… *Neolasioptera convolvuli* (Felt)

Swellings are woody, monothalamous and 1-2 cm long. Usually a single orange larva lives in a central longitudinal channel with no evident fungal associate. The elongate, cylindrical, yellow larva overwinters in the gall, and the adult emerges in spring. Hosts: *C. sepium*, *Calystegia* sp. Distr.: Massachusetts, New York, Maryland, West Virginia and Nebraska.

Ipomoea (morning glory)

1a Tapered stem swelling …… *Neolasioptera* sp.

Host: *Ipomoea* sp. Distr.: Florida.

1b Swollen flower …… *Asphondylia* sp.

Adult specimens in the USNM are labelled as reared from flowers and seeds. Host. *I. triloba*. Distr.: Florida.

Cornaceae

Cornus (dogwood)

1a Leaf galls …… 2
1b Bud and stem galls …… 3

2a Tubular leaf gall, Plate 57 (1b) ..... *Craneiobia tuba* (Stebbins)

These striking, green to pinkish, monothalamous galls are hemispherical on one side of the leaf, tubular and upright on the other, regardless of the leaf surface. The orange larva lives in a spherical chamber at the base of the gall. Hosts: *C. amomum*, *C. drummondii*, *S. racemosa*. Distr.: Ontario, Massachusetts, New York, Illinois and Iowa.

2b Circular or oval, reddish, blister gall, Plate 57 (1a) .....
..... *Parallelodiplosis subtruncata* (Felt) and *Lasioptera corni* Felt

P. subtruncata. This species is in every active blister gall I have seen on this tree, so is presumably the gall maker. Some other *Parallelodiplosis* species are inquilines in galls of other insects. Galls are about 4 mm in diameter and usually on the leaf lamina, more rarely on the veins and petiole. Galls are present all summer, so several generations may occur each season. Larvae, white when young, become deep red and very active when mature. Full-grown larvae leave the gall through a slit on the underside of the leaf. Hosts: *C. amomum*, *C. florida, C. racemosa*, *C. sericea*. Distr.: Massachusetts through Ontario to Minnesota, south to Oklahoma and Maryland and Idaho. Eiseman 2025a.

L. corni. Reported twice from these galls, each time from a single female, this species may be an inquiline. Hosts: *C. drummondii*, *C. florida*. Distr.: Oklahoma, New York.

3a Ovoid apical bud swelling ..... *Dasineura* sp.

Dasineura sp. Galls are found in June, are green, usually longer than 1 cm and often encompass a subapical node. Full-grown larvae are red-orange and gregarious in the hollow gall interior. Adults emerge the following April. Hosts: *C. drummondii*, *C. sericea*. Distr.: Massachusetts, New York, Oklahoma. See on BugGuide.

3b Stem swellings 4
4a Clavate stem swelling at branch apex, Plate 57 (3) ..... *Resseliella clavula* (Beutenmüller)

Dogwood club gall. Eggs are deposited among terminal leaves in spring. Young larvae find their way into the buds and one to several develop in a central chamber. Affected twigs are usually killed beyond the galls except for a pair of leaves that soon wilt. Swellings are 2-3 cm long and green to red. They are especially conspicuous in autumn after the orange larvae have exited from the apex and dropped to the ground to diapause through winter. This species has one generation per year. Host: *C. florida*. Distr.: Massachusetts to Ontario and Indiana, south to Florida. Schread 1964.

4b Stem swelling between nodes 5
5a Stem swelling prominent, rough-textured, Plate 57 (2) .....
..... *Neolasioptera cornicola* (Beutenmüller)

Swellings are woody, tapered, rough-textured, one-half to several centimeters long, usually to one side of the stem and contain several yellow larvae that overwinter inside and emerge

in spring. One generation occurs per year. Hosts: *C. amomum*, *C. alterniflora*, *C. sericea*. Distr.: Iowa, New York, West Virginia, Maryland.

5b Stem swelling very slight, smooth …… *"Cecidomyia" ramuli* (Felt)

This species, known only from a female still not referable to genus, was reared from a small, monothalamous enlargement on smaller twigs. Its role in the stems is unknown; it may be a fungivore. Host: *C. racemosa*. Distr.: New York.

Cucurbitaceae

Citrullus (watermelon), ***Cucumis*** (melon), ***Cucurbita*** (gourd)

1a On fruit of *Cucumis* …… *Neolasioptera hibisci* (Felt)

Larvae on this plant were originally noticed on fruit from Honduras intercepted at Miami, Florida. Later in Honduras, larvae were found on the corky end of cantaloupe and subsequently reared to the adult stage. Initially found in the pith of irregular, ridged stem galls on *Hibiscus* and later reported from the stems of cultivated lilies, this species is evidently a generalist. Hosts: *Cucumis melo*; also, *Hibiscus* and possibly *Lilium*, q.v. Distr.: New York, North Carolina and Louisiana; also, Honduras and Guatemala. Gagné 1994.

1b Deformed or swollen buds or leaves …… 2
2a Curled leaf buds and rolled young leaves …… *Prodiplosis citrulli* (Felt) and cecidomyiid

P. citrulli, Cucurbit gall midge. Larvae are white, gregarious and develop rapidly. Infested leaves die after the full-grown larvae drop to the soil. Several generations probably occur per year. Hosts: cultivated *Citrullus*, *Cucumis* and *Cucurbita*. Distr.: Arizona. Wehrle 1946.

Cecidomyiid. Two gall midges were reportedly reared together from curled, slightly enlarged tips of melon (Lintner 1897). One of them, *Contarinia setigera* (Lintner) is very similar to the distinctive *Contarinia pyrivora*, the pear midge, so is suspected to have been a contaminant in the rearing cage (Gagné 1989). The other cecidomyiid noted at the same time was an aphid predator, *Aphidoletes aphidimyza* (Rondani), so it is possible that the curled tips described by Lintner were caused by aphids. Host: *Cucumis* sp. (muskmelon). Distr.: Massachusetts.

2b Swollen flower or flower bud …… *Asphondylia* sp.

A series of this species in the USNM is labelled as reared from melon, but its exact niche is unknown. Host: cultivated *Cucumis* sp. Distr.: Arizona.

Cupressaceae

Calocedrus (incense cedar)

1a Slight swelling of leaf midrib …… *Contarinia* sp.

One bright orange larva lives in each convex swelling, a mere blister with no apparent hypertrophy. Galls were collected in late September and adults emerged late in April. Host: *C. decurrens*. Distr.: Oregon.

1b Abnormally swollen buds …… 2

Four kinds of bud galls made by undescribed species of Walshomyia have been reported on *C. decurrens* in California by Russo (2021). Galls are evident as early as February. Larvae pupate in situ and adults emerge from them in April or May. Where and in which larval stage these species live through the rest of the year is unknown.

2a Galls with several elongate, spiky bracts …… 3
2b Galls spheroid, with or without short, sparse, pointed bracts …… 4
3a Terminal, green, four-sided buds with stiff, spiky bracts, 10-15 mm long and 8-10 mm wide ……
…… *Walshomyia* sp. "A" of Russo (2021)

Galls were first noted in Felt (1940, 1965) and rediscovered and photographed by Russo (2021).

3b Subterminal, bright green galls, 15-20 mm long and 7 mm wide, a pointed branch extension emerging from apex of gall …… *Walshomyia* sp. "D" of Russo (2021)
4a Galls heart-shaped, 6 mm long by 3 mm wide, the bracts separate and short-pointed ……
…… *Walshomyia* sp. sp. "B" of Russo (2021)
4b Galls spheroid, yellow, 15-20 mm long and 7 mm wide, the bracts closely joined ……
…… *Walshomyia* sp. "C" of Russo (2021)

Callitropsis (Nootka cypress)

Slightly swollen branchlet comprised of swollen leaf scales, Plate 58 (1) ……
…… *Chamaediplosis nootkatensis* Gagné

C. nootkatensis. Galls are about 3 mm in diameter and conspicuous for their yellow color. Most overwintering larvae pupate in situ in late winter, adults appearing shortly after. There may be two generations per year. Host: *C. nootkatensis*; also *Hesperocyparis pigmaea*. Distr.: British Columbia to California. Gagné and Duncan 1990, Russo 2021.

Chamaecyparis (cedar)

Larva in cone, Plate 58 (2) …… *Cupressatia siskiyou* Felt and *Contarinia* sp.

C. siskiyou. Infested cones may appear normal to slightly deformed. Larvae lie against the aborted ovaries. In summer. They spin a cocoon in place where they pupate in spring. Adults

emerge shortly after. Probably only one generation occurs per year. Host: *C. lawsoniana*. Distr.: Washington, Oregon; also Europe, where it was introduced sometime before 1931 and is now well established. Meijere 1935, Nijveldt 1984, Gagné 2013.

Contarinia sp. This item in the USNM is known from a single male reared from a cone. Host: *C. lawsoniana*. Distr.: Washington.

Cupressus (see *Callitropsis* and *Hesperocyparis*)

Hesperocyparis (western cypress)

1a Greatly enlarged terminal bud, about 30 mm long, Plate 58 (4) …… *Walshomyia cupressi* Gagné

Each gall contains at its center a single larva that pupates in situ. Adults emerge in April. Hosts: *H. pigmaea*, *H. sargentii*. Distr.: California. Russo 2021.

1b Barely detectable swellings of branchlet tips, Plate 58 (3) …… *Chamaediplosis* spp.

Chamaediplosis rugosa Gagné. This species causes only slight swellings, about 1 mm diameter. Infestation is noticeable in spring, when the green buds turn, first red, then, after the full-grown larvae drop to the soil, brown. Host: *H. arizonica*. Distr.: California; also Hawaii, where it was introduced with nursery stock. Gagné 1986a, Gagné and Duncan 1990.

Chamaediplosis sp. The damage is similar to that of *C. rugosa*, but the gall midge is distinct and occurs on different species of *Hesperocyparis*. Hosts: *H. macrocarpa*, *H. pigmaea*. Distr.: California. Gagné 1986a, Russo 2021.

Juniperus (juniper)

Among the gall midges of juniper are many species of *Oligotrophus* and *Walshomyia* of which very little is known. See White (1950) for figures of five galls on *Juniperus mexicana* found in the vicinity of Austin, Texas. *Walshomyia* occurs only on Cupressaceae of western North America and seems especially diverse. Larvae of both genera pupate in the galls.

1a Discoloration below tip of branchlet, Plate 58 (5), See Image 45 ……. *Contarinia juniperina* Felt

Juniper midge. Feeding sites are 2-3 mm long and 5-20 mm from the branchlet apex and light brown to red in early spring. The single larva in each gall overwinters as a second instar in an ovoid chamber nearly encompassing the diameter of the branchlet and surrounding the central vessel. The full-grown larvae, orange to red and c-shaped, drop to the soil in early spring. Larvae pupate directly and adults emerge a few weeks later. Wheeler et al. (1981) reported that large infestations can cause extensive dieback and unsightliness on cultivated junipers. Hosts: *J. ashei*, *J. chinensis*, *J. communis*, *J. horizontalis*, *J. sabina*, *J. squamata*, *J. virginiana*. Distr.: Ontario to Maryland, west to Nebraska and Kansas. Haseman & McLane 1940, Wheeler et al. 1981, Steinhauer 1983.

1b Slight or large swellings on bud tips 2
2a Gall covered with imbricated needles, sometimes inconspicuous 3
2b Gall fruitlike, not covered with imbricated needles 5
3a Gall surrounded by two to several needles, barely larger in diameter than normal twig, Plate 58 (6, 13) ..... *Oligotrophus betheli* Felt, *Oligotrophus* sp. and *Walshomyia insignis* Felt

O. betheli Felt, juniper tip midge, Plate 58 (13). The needles covering a gall are green at first and become discolored when the larva inside approaches full growth. Two to several generations occur per year. The last overwinters in the galls as full-grown larvae, pupates there in spring and emerges as adults shortly after. Eggs are laid in groups on the buds, but each branch tip has only one gall and each gall one larva. Affected buds die after the gall midges emerge. Heavily infested plants have a light brown cast. Hosts: *J. ashei*, *J. chinensis*, *J. horizontalis*, *J. osteosperma*, *J. scopulorum*, *J. virginiana*. Distr.: New Jersey to British Columbia and California. Appleby and Neiswander 1965, Wheeler et al. 1981, Russo 2021.

Oligotrophus sp. This species, probably an *Oligotrophus*, is known from galls and pupae. Galls differ from those of *O. betheli* only by the recurved outer leaf scales. Host: *J. scopulorum*. Distr.: Colorado.

W. insignis. Galls were apparently collected only once and reported as yellowish bud galls, hardly distinguishable from normal buds. That short description could also fit the description of *O. betheli* galls, but the one known specimen, a female, of *W. insignis* is distinct. Host: *J. scopulorum*. Distr.: Texas.

3b Gall much larger than normal twig diameter, consisting of many enlarged needles 4
4a Gall burrlike, the leaves short, erect, outwardly pointed, Plate 58 (12) .... *Oligotrophus juniperi* (Felt)

This species is known from a single female. Host: *Juniperus* sp. Distr.: Colorado, California. Russo 2021.

4b Leaves forming gall appressed, although tips may be reflexed, Plate 58 (9, 10, 14) .... *Oligotrophus pattersoni* White and *Walshomyia* spp.

O. pattersoni Plate 58 (10). Galls are 10-15 mm long, 8-10 mm in widest diameter. Host: *J. ashei*. Distr.: Texas. White 1950.

Walshomyia spp. Plate 58 (9, 14). Two kinds of galls from the USNM collection are shown as samples of the variety of imbricate bud galls that can be found on junipers. These are presumed to be caused by *Walshomyia* spp. The gall on Plate 58 (9) is from *J. occidentalis* in California; that shown on Plate 58 (14) is from *J. osteosperma* in Colorado. Russo (2021) has photos of galls that look similar to these that he labels respectively as *Walshomyia* sp. "B" and *Walshomyia* sp. "A." He collected those galls from additional species of juniper in California, the first from *J. californica* and *J. occidentalis* and the second from *J. osteosperma*.

5a Gall elongate-cylindrical, Plate 58 (7) ..... *Walshomyia* sp.

The galls shown are from the USNM collection and are only assumed to be formed by a *Walshomyia*. A generally similar gall is illustrated in Russo 2021 as the juniper tube gall midge, "*Walshomyia* sp. C." Galls are yellow to brown and split open at the apex when the larvae are full-grown. Host: *J. osteosperma*. Distr.: Colorado, California.

5b Gall ovoid, globular, pink to dark purple, Plate 58 (8) ..... *Walshomyia* spp.

Galls of all three species listed below are much alike, pink to purple, 5-10 mm long, 4-8 mm at widest diameter and sometimes split apically when mature. Each contains in a central chamber a larva that overwinters in the gall and pupates in situ in spring. Russo 2021.

W. juniperina Felt. Spheroidal galls on *J. monosperma* from Arizona eventually break open at the apex and become urnlike in shape. A series of a *Dasineura* (s.l.) sp. larvae was collected crawling away from the galls. Hosts: *J. californica*, *J. monosperma*, *J. occidentalis*. Distr.: California, Arizona. Russo 2021.

W. sabinae (Patterson). This species was recorded from *J. ashei* (as *sabinoides*) in Texas and the species description was based only on the gall. Adults of an alleged synonym of this gall midge, *W. sabinae* Felt, were reared from *J. monosperma* in Colorado and from *J. osteosperma* in Utah. Specimens have not been reared from galls of *W. sabinae* (Patterson), which will have to be done to determine whether the two names are distinct. Patterson's species may be synonymous with *W. texana* Felt, below, which was also reared from J. *ashei* (as "sabinoides").

W. texana Felt. Host: J. *ashei* (as "*sabinoides"*). Distr.: Texas.

Taxodium (bald cypress)

1a Swollen, aborted seed ..... *Sequoiomyia taxodii* (Felt)

Hard-walled galls replace seeds in cones where larvae overwinter to emerge in spring. Host: *T. distichum*. Distr.: Southeastern North America, including a Pleistocene fossil of the species found in Maryland.

1b Galls on branches, branchlets and needles 2

2a Woody swellings of branches, with open or closed resinous cavities, See Image 46 .....
..... *Cecidomyia lamellata* Gagné

Swellings are 2-3 cm long and 1-2 cm in diameter, the exterior similar in texture to a normal branch but harboring gregarious larvae in a resinous cavity. Larvae feed suspended in the resin except for their exposed, enlarged, hind pair of spiracles. Full-grown larvae spin individual cylindrical cocoons in the resin mass but not before turning end to end with their heads directed exteriorly. This allows the adult to break out headfirst from the pupa. Host: *T.*

distichum. Distr.: Florida. Gagné and Hibbard 2008.

2b Galls on branchlets or needles …… *Taxodiomyia* spp. 3

Bald cypress is host to at least ten simple and complex needle gall makers caused by *Taxodiomyia*. Only three have names. The genus is restricted to bald cypress, *Taxodium distichum*, and galls of most segregates have been found on both varieties, bald and pond cypress, *T. d. distichum* and *T. d. imbricarium*, respectively). One species, *Taxodiomyia cupressiananassa* (Osten Sacken), is distinct from its congeners in that it has at least two generations per season and its galls are large, prominent, persistent, multichambered and invest the tips of whole branchlets. The remaining segregates have one generation per season and their galls are single-chambered, occur on branchlets and needles and drop to the ground with the branchlets in autumn. Some of these are common throughout the natural range of *Taxodium*; others are apparently more restricted. Larvae overwinter in the galls without forming a cocoon. Initial investigations show that the species from single-chambered galls are anatomically very similar. In the key that follows, common names are coined for the separate galls, which mostly lack a scientific name.

3a Polythalamous, large 1 cm or longer, spongy enlargement at ends of branchlets with leaf rudiments protruding from surface, Plates 95 (1a), 96 (1) …… …… bald cypress pineapple gall, *Taxodiomyia cupressiananassa* (Osten Sacken)

The gall is spongy and covered with a white bloom when fresh but eventually turns brown. Protruding leaf ends around the surface give the gall the appearance of a pineapple. This species has two generations per year in Maryland and Illinois, possibly more farther south. When the larva of the overwintering generation is fully fed, it turns away from the axis, makes a tunnel through the soft, fibrous interior up to but not including the epidermis, and then enters diapause. Larvae of an inquiline, *Parallelodiplosis* sp., has been found in these galls. Distr.: Southeastern United Staes. Chen and Appleby 1984.

3b Monothalamous, affecting needles singly or in clusters …… 4
4a Group of adjacent swollen and curved needles, causing branchlet to bend, Plate 96 (2) …… …… bald cypress cluster gall
4b Simple swelling of separate needles or complex galls connected to needle by basal pad and separately dehiscible …… 5
5a Needles swollen along almost entire length or with small blister …… 6
5b Complex galls connected to needle by basal pad and separately dehiscible …… 7
6a Needle swollen along most of its length, Plates 95 (1c), 96 (3) …… …… bald cypress sausage gall, *Taxodiomyia taxodii* (Felt)
6a Needles with basal blister, not affecting entire needle, Plate 96 (4) …… bald cypress blister gall
7a Galls white …… 8
7b Galls green, yellow, red, or purple …… 9
8a Obconic gall with basal fringe, Plates 95 (1d) , 96 (5) …… …… bald cypress cup and saucer gall, *Taxodiomyia cupressi* (Schweinitz)
8b Spheroid gall, surface covered with conical extensions, Plates 95 (1b), 96 (6) …… …… bald cypress white starburst gall

9a Galls with short or long conical extensions 10
9b Galls without conical extensions 12
10a Galls with one or more rows of short extensions around girth, not obscuring otherwise bare surface, Plate 97 (1) ..... bald cypress fringed gall
10b Galls entirely covered with conical or aciculate extensions 11
11a Gall covered with short-conical extensions, Plates 95 (1b), 97 (4) .... bald cypress yellow starburst gall
11b Gall covered with aciculate extensions, Plate 97 (5) ..... bald cypress medusa gall
12a Gall flat with two quadrate, winglike extensions, purple, Plate 97 (6) .... bald cypress bow-tie gall
12b Gall evenly spheroid or formed of two opposite conical extensions 13
13a Gall evenly spheroid, Plate 97 (2) ..... bald cypress pea gall
13b Gall formed of two opposite conical extensions, Plate 97 (3) ..... bald cypress two-horned gall

Thuja (arborvitae)

Larva in cone, Plate 58 (11) ..... *Cupressatia thujae* (Hedlin)

Eggs are laid in early spring on the inner surface of cone scales. Newly hatched larvae migrate to the fertile portion of the cone and feed on the surface of developing seeds and larger scales. Damaged cones are smaller and slightly misshapen. Seeds rarely survive infestation. Full-grown larvae spin cocoons in the cones in late summer or early fall. Adults emerge the following spring. Host: *T. plicata*, western red cedar. Distr.: British Columbia to Oregon. Hedlin 1964b, Gagné 2013, Russo 2021.

Cyperaceae

Carex (sedge)

Sedges are home to a small universe of poorly known gall midges that occur throughout the Holarctic region. Comprehensive study will be necessary to obtain even a preliminary grasp of this gall midge fauna. The perigynium of possibly every species of sedge contains at least one species of gall midge, possibly two or three, all belonging to species groups still undifferentiated from within the large genus *Dasineura* (recent pers. obs.). Their niches include species-specific deformations of the perigynium (See Image 47), pistils and the perigynial sinus. Additionally, tuber-shaped galls caused by *Planetella* are found in swellings of the culms or crowns of sedges (Plate 58 (15, 16). Sixty-four species of this genus are known in the Holarctic Region; unfortunately, most are known only from adults caught in flight. Of the 24 named North American species of *Planetella*, only two have been reared, one from *Carex*, the other from *Cyperus*. At least 15 European species have been reared from sedges, enough to establish that *Planetella* is a specialist of Cyperaceae (Roskam 2019). The only species reared from a non-cyperaceous host is the Japanese *Planetella bambusae* Felt, which came from bamboo (Poaceae), but its type series is so poorly mounted that the generic placement cannot be confirmed. Finally, unidentified gall midge larvae have been found crawling upon stem bases (See Image 48) and a species of *Contarinia* was discovered feeding externally on perigynia of *Carex nigra* in Maine (Eiseman 2025a),

Cyperus (flatsedge)

From unspecified shoot gall at base of plant ..... *Planetella caudata* (Felt)

Host: The plant host was only tentatively identified as a *Cyperus*. Distr.: Tennessee.

Dulichium (dulichium)

In fruit ..... *Ametrodiplosis dulichii* (Felt)

Adults were reared from the larval stage. Host: *D. arundinaceum*. Distr.: Massachusetts.

Dioscoreaceae

Dioscorea (yam)

Irregular, woody swelling at base of leaf blade, Plate 58 (17) ..... *Neolasioptera* sp.

Adults of this species have not been reared. Larvae presumably overwinter in the gall. Host: *D. villosa*. Distr.: New York.

Elaeagnaceae

Elaeagnus (oleaster)

Raised blister on leaf ..... *Contarinia* sp.

The gall contains a single larva, yellow when full-grown, in a roomy chamber. Host: *E. commutata*. Distr.: Alberta.

Shepherdia (buffaloberry)

Enlarged flower bud, Plate 59 (1) ..... *Asphondylia shepherdiae* Felt

Infested buds are thin-walled, yellowish green to red and 4-5 mm in diameter. Adults were reared in late June. Host: *S. canadensis*. Distr.: Colorado.

Ephedraceae

Ephedra (joint fir)

1a Subglobular, non-resinous stem swelling, Plate 77 (1) ..... *Lasioptera ephedrae* Cockerell

The monothalamous swellings are dimpled, the same color as the normal stem and about 10-15 mm long and 5 mm in diameter at midlength. The larva feeds along the pith. Pupation occurs in the gall and the pupa exits in spring through the depression on one side where the wall is thinnest. Hosts: *E. nevadensis*, *E. trifurca*. Distr.: New Mexico to California. Herman et al. 1993, Russo 2021, Eiseman 2025a.

1b Irregular, resinous stem swelling, Plate 77 (2) …… *Lasioptera ephedricola* Cockerell and *Lasioptera* sp.

L. ephedricola. Swellings are rugose and discolored, 10-30 mm long and 4-5 mm wide and usually polythalamous. Occasionally a gall with only one larva inside will show only an inconspicuous swelling. Larvae live in fungus-lined tunnels, the fungus eventually turning black. Adults emerge in February to March. Hosts: *E. californica*, *E. nevadensis*, *E. trifurca*. Distr.: New Mexico to California. Herman et al. 1993, Russo 2021.

Lasioptera sp. A few specimens of an unidentified and distinct species were reared together with *L. ephedricola*. Host: *Ephedra* sp. Distr.: Arizona.

Ericaceae

Arctostaphylos (manzanita)

1a Rosette of leaves on stem bud …… 2
1b Swelling of stem or petiole …… 3
2a Rosette large, bearing many individual galls, See Image 49 …… cecidomyiid

Galls were found in late March. Host: *A. pringeli* ssp. *drupacea*. Distr.: Southern California.

2b Rosette narrow, bearing a single, larval chamber …… cecidomyiid

Galls were found in late August. Host: *A. uva-ursi*. Distr.: Alaska. See on iNaturalist.

3a Tapered stem swelling …… *Dasineura hildebrandi* Felt

Swellings are about 10 mm long and 5 mm in diameter. Host: *Arctostaphylos* sp. Distr.: California.

3b Swollen petiole …… *Contarinia* sp. and *Resseliella* sp.

Larvae of both *Contarinia* and *Resseliella* were found together in swellings about 5 mm long and 3 mm in diameter that were intercepted at the United States-Mexico border at Laredo, Texas. Host: *Arctostaphylos* sp. Distr.: Mexico (unspecified).

Gaylussacia (huckleberry)

Rolled leaf edge …… cecidomyiid

Host: *G. baccata*. Distr.: Massachusetts. Eiseman & Blyth 2022.

Monotropa (Indian-pipe)

In leaf …… cecidomyiid

The single known larva was associated with a dead stem. It is identifiable only to Cecidomyiidi. Host: *M.* ?*uniflora*. Distr.: Maine. See on BugGuide.

Rhododendron (azalea, rhododendron)

1b Rolled, distorted, young leaf …… *Clinodiplosis rhododendri* (Felt)

Rhododendron gall midge. Leaves develop an inrolling of the lower leaf margin. Young leaves may be killed, dwarfed or deformed. Larvae develop rapidly and in several days are full-grown and drop to the soil. The species is multivoltine. Hosts: *R. catawbiense*, *R. maximum*. Distr.: New York to North Carolina. Specker & Johnson 1988, Hanula 1991, ElSayed et al. 2023.

1a Enlarged leaf or flower bud …… 2
2a Enlarged leaf bud, Plate 59 (4) …… *Asphondylia azaleae* Felt

Infested buds are 8-12 mm long. A single larva lives in a fungus-lined chamber at the bud's center. Adults emerge from the buds in spring when the plant begins to bloom, then lay eggs in the next year's leaf buds. Hosts: *R. calendulaceum*, *R. periclymenoides* and *R. prinophyllum*. Distr.: New York, Massachusetts, Maryland and Virginia.

2b Enlarged flower bud, See Image 50 …… *Dasineura praecox* Gagné

This gall midge has an unusual life history for its genus. Infested flower buds become greatly enlarged in March before flowers normally bloom in Maryland. In mid-April as many as 75 full-grown yellow larvae may be found among the aborted flowers in a still unopened bud and soon drop to the soil. Larvae remain there through the summer, pupate in autumn, emerge as adults in October and lay eggs between flower bud scales. Larvae soon develop within their eggs, but remain inside as first instars through January. In February the larvae finally hatch and crawl to the primordial stamens and pistils where they begin to feed. Adult emergence in most species of *Dasineura* usually takes place in spring, which would be too late for *D. praecox*. In February when the azaleas begin to burgeon the frozen soil would impede adult emergence. By flying in autumn, the adults steal a march on spring. Hosts: *R. periclymenoides*, *Rhododendron* sp. (a deciduous hybrid). Distr.: Massachusetts, Maryland. Gagné 1996.

Vaccinium (blueberry, cranberry)

1a Swollen berry, See Image 51 ..... *Dasineura* sp. and *Lasioptera fructuaria* Felt

Dasineura sp. Infested fruit enlarge sooner than normal and become bright red instead of blue. Full-grown larvae leave the berries, which then dehisce. Host: *V. stamineum*. Distr.: Georgia.

L. fructuaria. One to several reddish larvae are found in a berry, which grows deformed. The report that this insect is bivoltine and drops to the ground to pupate may refer instead to the *Dasineura*. Distr.: Maine, Georgia. Woods 1915.

1b Bud or leaf gall 2

2a Leaf buds with swollen, curved leaves, Plate 59 (3) .....
Dasineura cyanococci Felt, *Dasineura oxycoccana* (Johnson) and *Prodiplosis vaccinii* (Felt)

These three species reportedly cause similar damage. First the terminal buds and, later in the season, the lateral buds become swollen and their outer leaves cupped. Larvae live on the inside surface of the curled leaves. They may pupate in the buds or drop to the ground when full-grown at which time the bud dies, turning black and brittle. The two *Dasineura* species may be distinct, especially in view of molecular and behavioral evidence by Cook et al. (2012), Mathur et al. (2012) and Kim et al. (2022) that appears to restrict *D. oxycoccana* to cranberry. Papers by Bosio et al. 1998. Reekie et al. 2009 and Hahn & Isaacs 2012 use the name *D. oxycoccana* for the gall midge on blueberries.

D. cyanococci. This species was reared from an apical bud gall on a blueberry, possibly *V. myrtilloides* (as *canadense*) (Felt 1915a) and resembles *D. oxycoccana*. Adults emerged 10-15 days after full-grown larvae dropped to the soil. Hosts: V. *myrtiloides* and possibly commercial blueberries. Distr.: Massachusetts, New Jersey and Georgia.

D. oxycoccana. The yellow to red larvae either pupate in the buds or drop to the ground. There may be several generations per year, from early May to September. The later brood is the most injurious because injured tips rarely recover in time to set fruit buds for the following season. Host: *Vaccinium macrocarpon*. Distr.: Massachusetts, New Jersey, Michigan, Wisconsin and Washington; an immigrant in Europe and Asia. Tokuda & Uechi 2021.

P. vaccinii, blueberry tip midge. Several generations of this species may occur per year. Eggs are laid in unfolding leaf buds. Full-grown larvae drop to the soil where they form cocoons. Host: *Vaccinium* sp. (commercial blueberries). Distr.: New Jersey, Pennsylvania, Mississippi; immigrant in Spain (Calvo et al. 2004) and Korea (Choi et al. 2025). Driggers 1926.

2b Leaf galls 3

3a Leaf spot, Plate 59 (2) ..... *Contarinia* sp.

Larvae live in a sticky substance in a slight depression on the underside of the leaf. The upper

side of the leaf is slightly dimpled. Usually, one larva but as many as three live on one spot. Spots are oval, about 4 mm wide, 10 mm long and reddish or a lighter green than the leaf when viewed from above. Larvae were found in early August at high altitudes. Full-grown larvae drop to the soil. Hosts: *Vaccinium* spp. (both red- and blue-berried species). Distr.: Washington, Ontario.

3b Marginal leaf roll or vein swelling 4
4a Red, swollen marginal leaf roll ..... cecidomyiid

Leaf edges are bright red and curled toward the lower leaf margin. Hosts: *V. stenophyllum*, *V. corymbosum*, *V. uliginosum*. Distr.: New Hampshire, Massachusetts. Eiseman 2025a.

4b Succulent, scallop-shaped swelling on midrib on underside of leaf, Plate 59 (5) ..... *Vaccinidiplosis vaccinii* (Osten Sacken)

Galls are red, about 10 mm long and 5 mm high. They are an outgrowth of the underside of the leaf adjacent to the main vein and not apparent from the upper leaf surface. Individual galls contain one to several larvae that develop slowly at first but grow rapidly in late summer. When fully grown the then reddish larvae escape through the scalloped outer margin of the gall and drop to the ground where they burrow before forming cocoons. Adults emerge the following year. Hosts: *V. stamineum*, deerberry. Distr.: Pennsylvania to Maine, south to Georgia. Gagné and Payne 1994.

Euphorbiaceae

Acalypha (copperleaf)

Swollen flower buds, Plate 60 (7) ..... *Resseliella globosa* Plakidas

Galls are found in summer. The several larvae in a gall drop to the soil in September. Hosts: *A. rhomboidea*, *A. graciliens*. Distr.: Illinois to New York.

Croton (croton)

Tightly rolled leaf at plant apex, See Image 52 ..... *Lopesia* sp.

The young leaves are folded in half, the halves convex, enveloping gregarious yellow larvae that drop to the soil when full-grown in late July. Adults emerged in early August of the same season. Host: *C. glandulosa*. Distr.: Oklahoma.

Euphorbia (spurge)

In addition to the species in the key below, *Prodiplosis myricae*, originally described from buds of *Myrica* (Myricaceae), was reared in association with leaf mines of *Liriomyza* sp. (Diptera: Agromyzidae) on *Euphorbia curtisii* in North Carolina.

1a Leafy, rosette galls, as on Plate 23 (1) … *Spurgia capitigena* (Bremi) and *Spurgia esulae* Gagné

S. capitigena. This species forms large, leafy, lateral and apical rosette bud galls. It has at least two generations per year. Heavily attacked plants do not produce flowers. Pupation occurs in cocoons in or near the galls or in the ground. This species was accidentally introduced into Saskatchewan and North Dakota with *Spurgia esulae* (see below). Host: *E. cyparissias*. Distr.: Saskatchewan, North Dakota and Montana; Europe. Gagné 1990, Nelson and Carlson 1999.

S. esulae. This European species was purposely introduced into Montana in 1985 to help control leafy spurge and soon became established. The biology is similar to that of *S. capitigena* but on a different host. Host: *E. esula*. Distr.: North Dakota and Montana; Europe. Solinas and Pecora 1984, Gagné 1990b, Pecora et al. 1991, Nelson and Carlson 1999.

1b Closed shoot tip gall or non-leafy, modified flowers …… 2
2a Shoot tip gall formed of two layers of leaves …… *Dasineura* sp.

Apical buds are aborted and turn black as soon as the gregarious full-grown larvae drop to the soil to pupate. Hosts: *E. capitellata*, E *corollata*. Distr.: Iowa. See on BugGuide.

2b Non-leafy, modified flowers …… 3
3a Spheroidal, spongy flower gall, See Image 53 …… *Schizomyia* sp.

The gall is a light green, greatly swollen, lobed, spongy cyathium. The 1-10 larvae inside live in individual chambers. The affected seed pod varies in size depending on the number of larval chambers. Full-grown red larvae drop to the soil in late summer and emerge the following spring. Host: *E. corollata*, *Euphorbia* sp. Distr.: Illinois, Texas, West Virginia.

3b Ampule-shaped, modified flower galls, See Image 54 …… cecidomyiid

This deformation is one of possibly three separate kinds of modified flowers on apical galls from Arizona, of which nothing further is known. Hosts: *Euphorbia* sp. Distr.: Arizona.

Fabaceae

Four gall midge genera, *Asphondylia*, *Dasineura*, *Contarinia* and *Neolasioptera*, predominate on North American legumes. *Asphondylia* species form many flower and pod galls; those that occur on the subfamily Mimosoideae appear only distantly related to those on the subfamilies Papilionoideae and Caesalpinioideae, and each of these groups of *Asphondylia* is distinct from the Old World species on Fabaceae (Gagné and Wuensche 1986, Gagné and Orphanides 1992). *Dasineura* spp. and *Contarinia* spp. are responsible for many leaf folds and marginal leaf rolls, *Contarinia* larvae are commonly taken in flowers and *Neolasioptera* spp. from stem swellings.

Acacia (see *Senegalia* and *Vachellia*)

Amorpha (false indigo)

1a Elongate, cylindrical or conical galls on leaflets, rachis, or flower stalk, Plate 59 (6) … ……. *Dasineura* spp.

Galls may be green or red, are about 4 mm long and often occur in long series. They are commonly found on the lower leaf surface of leaves and are variable in appearance, an indication that more than one species may cause these galls. They belong to *Dasineura* only in the broad sense. Pupation occurs inside the galls. Hosts: *A. canescens*, *A. fruticosa*. Distr.: Minnesota to Texas. See on BugGuide.

1b Swollen rachis or rolled or folded leaflets …… 2
2a Slight swelling of rachis …… *Neolasioptera* sp.

Galls were found in mid-August in Iowa. Each gall was inhabited by a single red larva filling the pith. Leaflets adjacent or above the swelling were wilted or shriveled. Host: *Amorpha fruticosa*. Distr.: Iowa. See on BugGuide.

2b Rolled or folded leaf …… 3
3a Marginal leaflet roll, Plate 59 (7) …… cecidomyiid

Rolled margins are reportedly 3-5 mm long and yellowish. Host: *A. canescens*. Distr.: Kansas. Wells 1921b.

3b Leaflet folded in half …… *Dasineura* sp.

Affected leaflets turn red. Host: *Amorpha canescens*. Distr.: Minnesota, Iowa.

Amphicarpaea (hogpeanut)

Stem swelling …… *Lasioptera* sp. or *Neolasioptera* sp.

Originally referred to *Lasioptera* (Felt 1940, 1965) based on the gall alone, this species may instead belong to *Neolasioptera*, the much more common genus in stem swellings in North America, especially in Fabaceae. Host: *A. bracteata*. Distr.: unspecified.

Apios (ground-nut)

Stem swelling …… *Neolasioptera* sp.

Swellings are spheroid and much broader than the spindly stems. Adults emerged July 29-30 from galls collected on July 22, indicating that this gall midge has more than one generation per year. Host: *Apios americana*. Distr.: North Carolina. See on iNaturalist.

Astragalus

Petiole swelling …… *Dasineura* sp.

Swellings are irregular, warty, 5-10 mm long and 5-8 mm in diameter. Referred to *Cecidomyia* by Felt (1940, 1965), larval specimens in the Felt collection belong to *Dasineura* in the broad sense. The adult has not been reared. Host: *Astragalus* sp. Distr.: New Mexico.

Baptisia (wild indigo)

1a Slightly swollen stem …… *Neolasioptera* sp.

The gall maker is unknown and only tentatively referred to *Neolasioptera*. Host: *Baptisia* sp. Distr.: New York.

1b Deformed pods …… *Asphondylia* sp.

Infested pods are seedless. Adults emerge in summer from the pods that remain green instead of normally turning black in autumn. The overwintering site of this species is unknown. Host: *B. tinctoria*. Distr.: Massachusetts.

Cercis (redbud)

1a In circular, slightly convex, leaf blister …… *Neolasioptera* sp.

Galls are 3 mm in diameter, an inconspicuous blister initially, but more noticeable after larvae have exited and the spot turns black. Several generations occur per season, beginning as early as mid-April in Maryland and extending into October. Host: *C. canadensis*. Distr.: West Virginia, Maryland and Florida.

1b In basal petiole swelling, See Image 55 …… *Contarinia* sp. and *Dasineura* sp.

Larvae of both genera were taken from the galls in early spring but adults have not been reared. Swellings are visible at the base of petioles before the leaves are fully unfurled. Each gall has one or five pink larvae that drop to the soil in early to mid-May, after which the affected leaves droop and turn black. Host: *C. canadensis*. Distr.: West Virginia, Alabama.

Chamaecrista (cassia)

Swollen twig …… *Neolasioptera cassiae* (Felt)

Swellings are irregular, about 5 cm long and 5-6 mm in diameter. Adults emerge in spring. Host: *C. nictitans*. Distr.: Arizona.

Crotalaria (rattlebox)

1a Larva in tapered stem swelling …… *Neolasioptera crotalariae* (Stebbins)

Host: *C. sagittalis*. Distr.: Massachusetts.

1b Larva in pod …… *Asphondylia* sp.

Adults were reared from pods, but the damage was not further specified. Host: *C. pumila*. Distr.: Florida.

Cyamopsis (guar, clusterbean)

1a Closed, hard, swollen bud and sterile, deformed pod, Plate 59 (8) … *Asphondylia websteri* Felt

This native American generalist species is found on many fabaceous and other hosts. It has crossed over to guar, a crop originally from India. Several generations can occur yearly on this plant in Arizona. The cecidomyiid probably overwinters as an egg or first instar in dormant buds of one of its native host plants, but not on guar which overwinters only as seed. Hosts: *C. tetragonoloba*; see also under *Parkinsonia* for a complete list of known hosts. Distr. on guar: Oklahoma and Texas to Arizona; also Dominican Republic. Gagné and Wuensche 1986.

1b Open, swollen, discolored bud …… *Contarinia texana* (Felt)

Guar midge. This appears to be another native American species that has crossed over to guar. Females deposit eggs in flower buds. Several larvae in each bud cause swelling and discoloration. Buds abort after the full-grown larvae leave to pupate in the ground. There may be several generations per year. Up to 90% of the buds were aborted in some fields. Hosts: *C. tetragonoloba*, *Parkinsonia* spp. Distr.: Oklahoma and Texas to Arizona. Rogers 1972a, 1972b, 1974.

Cytisus (broom)

Deformed reproductive buds, bulbous at base, tapered beyond …… *Asphondylia pilosa* Kieffer

This gall midge is an introduction from Europe. Galls become apparent in early May. By early June full-grown galls are about 1 cm long, light green and covered with white hair. The basal half is made up of a chamber with a single larva or pupa. The distal, tapered half breaks off when the adult emerges in July or early August. Host: *C. scoparius*. Distr.: Washington and Oregon. Parnell 1964, Harris 2002, Markin and Horning 2010.

Dalea (prairie clover)

1a Larva in open flower bud or swollen flowers …… *Contarinia* sp.

Adults were reared in June. A possibly mycophagous *Clinodiplosis* and a predaceous *Lestodiplosis* were also reared from these flowers. Hosts: *D. enneandra, D. purpurea*. Distr.: South Dakota, Texas.

1b Swelling at base of lateral branch, See Image 56 ..... cecidomyiid

Galls were found in mid-June. Host: *Dalea* sp. Distr.: Oklahoma.

Desmanthus (bundleflower)

Larva in open flower bud ..... *Contarinia* sp.

Adults were reared in June. Host: *D. illinoensis*. Distr.: Texas.

Desmodium (tick-trefoil)

1a Swollen stem ..... *Neolasioptera desmodii* (Felt)

Swellings are usually spindleform but may be irregular and as long as 25 mm. Larvae overwinter in the stems and adults emerge in spring. Felt (1940, 1965) attributed a stem gall on *D. glutinosum* (as *grandiflorum*) to *Lasioptera hamata* Felt. Earlier, though, Felt (1907a, 1918a) had written only that *L. hamata* came from an unknown weed whose galls somewhat resembled those seen on *Desmodium*. For now, the host of Felt's *L. hamata* must be regarded as conjectural. Hosts: *D. canadense*, *D. cuspidatum*, *D. glutinosum*. Distr.: Minnesota, New York and New Jersey.

1b Bud gall 2
2a Swollen, rosette bud gall, Plate 45 (2) ..... *Clinodiplosis meibomiifoliae* (Beutenmüller)

Several larvae in a bud arrest the growth of leaves and abort the bud. Full-grown larvae drop to the soil to pupate. Adults were reared in July from larvae collected two weeks earlier. Several generations may occur per year. Host: *D. canadense*. Distr.: New Jersey.

2b Hard, elongate-oval, hollow, modified leaflets, Plate 59 (10) .....
..... *Dasineura meibomiae* (Beutenmüller)

Leaflets remain short and folded and become thick-walled and hard instead of lengthening and unfolding. Resulting galls are monothalamous, 8-22 mm long, 4-8 mm wide and often found in clusters of three or more. Galls were found in early July and occasionally contained also *Clinodiplosis* and *Youngomyia* larvae. Hosts: *D. laevigatum*, *D. obtusum*, *D. pauciflorum*. Distr.: New York to North Carolina.

Genista (broom)

Folded, apical leaflet ..... *Clinodiplosis* sp.

This damage was originally reported by Felt (1911) as possibly caused by the European *Dasineura genistamtorquens* (Kieffer), but Felt's specimens bearing this name comprise a larva and a female of a *Clinodiplosis*. The damage does resemble that made by various

Dasineura spp. on Fabaceae. Given that the host is an alien species, this gall could have been caused by a *Dasineura*, possibly even *D. genistamtorquens*. Host: *G. tinctoria*. Distr.: Massachusetts.

Gleditsia (locust)

1a Swollen stem, Plate 59 (15) ..... *Neolasioptera brevis* Gagné

In spring eggs are laid in rows on new shoots where larvae immediately bore into the tissue to form tunnels in the elongating stem. Adults emerge from the galls the following spring. Infested twigs cease growing from the apices, but sprouting may occur from the base of the swellings, changing the growth form of the tree. Host: *G. triacanthos*. Distr.: Connecticut to Michigan and Illinois. Gagné and Valley 1984, Wilson and Heaton 1987.

1b Leaflet gall 2
2a Swollen, folded or partially rolled leaflet, Plate 59 (14b) … *Dasineura gleditchiae* (Osten Sacken)

This gall midge may have five to seven generations per year. Eggs are laid singly or in clusters on the upper surface of developing leaflets. The outer edges of the leaflets wrap around the gregarious larvae to produce podlike galls. Full-grown larvae make a cocoon, either at the feeding site where they will pupate directly or in the ground. Affected leaflets die soon after larval feeding. Repeated defoliation can cause the death of small branches. Host: *G. triacanthos*. Distr.: widespread in North America, probably spread to the west coast with nursery stock; also introduced and now well-established throughout Europe, also Turkey and Russia (Far East) (Csóka et al. 2017). Schread 1959, Thompson et al. 1998.

2b Flat, ovoid blister, Plate 59 (14a) ..... *Meunieriella aquilonia* Gagné

Eggs are laid singly on either surface of developing leaflets, usually the lower. Each blister contains one larva that breaks out and drops to the ground when full-grown. The spot is inconspicuous, showing only a little chlorosis until the larva escapes, after which a brown spot develops. Two or more generations occur per year. Host: *G. triacanthos*. Distr.: Pennsylvania, Tennessee. Gagné and Valley 1984.

Glycine (soybean)

1a In pods ..... *Asphondylia yushimai* Yukawa and Uechi

Although not known to occur in North America, this important pest of soybeans is noted here because in 1982 a pupa was intercepted at the Port of Los Angeles, California, in a shipment of soybeans from Japan. This gall midge is known from Japan, China and Indonesia. In Japan, a species of *Prunus* serves as the overwintering host. Host: *Glycine max*. Distr.: Asia. Uechi et al. 2005.

1b In stems 2
2a In stems in association with a black fungus, see Image 57 ..... *Resseliella maxima* Gagné

Symptoms are flagging leaves and plant bases turning dark brown to black due to a fungal associate of this gall midge. Initial feeding appears to be confined to the phloem with larvae moving into the xylem and pith over time. Full-grown larvae are orange. More than one generation occurs per season. Full-grown larvae drop to the soil when full-grown; those of the last seasonal generation diapause through the winter and pupate the following spring. Host: *Glycine max*. Distr.: Nebraska, Iowa, South Dakota and Minnesota. Gagné et al. 2019.

2b In stems in association with a white fungus, see Image 58 … *Karshomyia* caulicola (Coquillett)

The white-mold gall midge. Larvae were found in the pith of soybean stems without discoloration or apparent damage. Originally found on poppy in New Hampshire in 1895, this species has been found more recently on soybean in Quebec and midwestern USA. It is widespread in Europe; in the Netherlands it has been found on white mold in stems of beans and potatoes and in the stems and pods of winter rape. Hosts: *G. max*, *Papaver* sp. and various commodities. Distr.: North America and Europe. Koch et al. 2020.

Havardia (havardia)

Aborted, deformed seed pods ..... *Asphondylia* sp.

Adults emerged in May. Host: *P. pallens*. Distr.: Nuevo Leon.

Lathyrus (vetchling, wild pea)

Tightly rolled leaflet ..... *Dasineura maritima* Felt

Adults were reared in spring from gregarious larvae collected in damaged leaflets the previous fall. Host: *L. japonicus*. Distr.: Massachusetts. Gagné & Strong 1993.

Lespedeza (lespedeza)

1a Swollen stem ..... *Neolasioptera* sp.

Only the gall is known. The gall maker is tentatively identified here as a *Neolasioptera*. Host: *L. violacea*. Distr.: unspecified.

1b Rolled green leaflet or white-haired bud gall 2
2a Rolled podlike leaflet ..... ?*Dasineura* sp.

The gall is probably caused by a *Dasineura*, but an inquilinous *Youngomyia* sp. was originally reported as the inhabitant (Felt 1940, 1965). Host: *L.* ``*decumbens*." Distr.: Massachusetts, Tennessee. Eiseman & Blyth 2022.

2b White-haired leaf or flower bud gall, Plate 60 (8) ..... cecidomyiids

Galls are either on leaves or flower buds and look like miniature pods. They are downy and green initially, turning purple after the full-grown larvae drop to the soil. Full-grown larvae of three species were found in these galls: white full-grown larvae without a spatula; orange larvae with a spatula, these more common than the white so probably the gall maker; and *Clinodiplosis* larvae whose mandibles on more than one occasion were noticed to be clinging to some of the orange larvae (pers. obs.). Hosts: *L. procumbens*, *L. repens*, *L. violacea*. Distr.: Alabama, West Virginia.

Lupinus (lupine)

In addition to the 3 items keyed below, a series in the USNM of an unidentified *Lasioptera* sp. from some unrecorded damage is labelled only, "on lupine, Tacoma, Wash."

1a Swollen, hairy bud gall, Plate 60 (5) ..... *Dasineura lupini* Felt

Swellings are up to 2 cm in diameter and made of imbricated bud scales surrounding a central chamber containing one to several larvae. Sometimes the galls bear leaves at their apices. Adults emerge from the galls in May. Host: *L. arboreus*. Distr.: California. Gagné & Strong 1993, Russo 2021.

1b Swollen stem or folded leaflet 2
2a Swollen stem, Plate 60 (4) ..... *Neolasioptera lupini* (Felt)

Swellings are variable in size, 1-3 cm long and contain one to several longitudinal larval chambers. Adults emerge from the galls in spring. Hosts: *L. arboreus*, *L. densiflorus*, *L. variicolor*. Distr.: Washington to California. Russo 2021.

2b Swollen, folded leaflet, Plate 60 (3) ..... *Dasineura lupinorum* Gagné

Eggs are laid on unopened leaflets of developing buds. Upon hatching, larvae crawl between the still closed halves of the unfolding leaflets. Up to several gregarious larvae may be found in the chamber formed within a fold. Hosts: *L. albifrons*, *L. arboreus*, *L. chamissonis*, *L. variicolor*. Distr.: Washington to California. Gagné and Strong 1993; Russo 2021.

Medicago (alfalfa)

1a Pod gall, Plate 60 (6) ..... *Asphondylia websteri* Felt

Alfalfa gall midge. Infested pods swell, but do not curl as pods normally do. The gall maker is multivoltine and pupates in the pod. This species probably overwinters as an egg or first instar in dormant buds of alfalfa or its native host or hosts. This insect is a native American species that has evidently crossed over to alfalfa. *Asphondylia miki* Wachtl, a distinctly different European species of *Asphondylia*, causes the same damage to alfalfa in Europe. Hosts: *M. sativa*; and see under *Parkinsonia* for complete list of known hosts. Distr. on alfalfa: Texas to California, and Guatemala. Webster 1912, Gagné and Wuensche 1986.

1b Basal stem swelling ..... possibly *Resseliella maxima* Gagné

Similar damage to that found on *Glycine max* (q.v.) was noticed on this plant. Host: *Medicago sativa*. Distribution: Nebraska.

Melilotus (sweet clover)

1b Basal stem swelling ..... possibly *Resseliella maxima* Gagné

Damage to this plant is similar to that found on *Glycine max* (q.v.). Host: *Melilotus* sp. Distribution: Nebraska.

Mimosa (sensitive plant)

1a Flower bud gall, as for Plate 59 (13) ..... *Hemiasphondylia mimosae* (Felt)

Found in clusters on flower peduncles, this gall is analogous to that of *Asphondylia prosopidis* on *Prosopis*. It is thin walled, smooth, greenish-pink and about 7 mm long by 3 mm in diameter. Pupation occurs inside the gall. The gall may fall off the tree before the adult gall midge emerges. Several generations may occur per year. Host: *M. borealis*. Distr.: Texas. Painter 1935.

1b Galls on other plant parts 2
2a Conical gall on bud, thorn, or leaf ..... *Asphondylia* sp.

Galls are brown, 7-10 mm long. This gall was attributed to Hemiasphondylia (as *Asphondylia*) *mimosae* by Painter (1935) but, if the situation on *Mimosa* is analagous to that on *Prosopis* (q.v.), this gall is probably made by a different species of *Asphondylia*. Mature larvae and pupae of both species need to be studied for a proper comparison. Larvae of an inquiline, possibly *Youngomyia* sp., were found in these galls in Arizona. Hosts: *M. borealis*, *M. aculeaticarpa*. Distr.: Texas, Arizona. Painter 1935.

2b Leaflet pairs joined, each forming a spheroid swelling, see Image 59 .....
..... *Lasioptera* sp. and cecidomyiid

Each leaf of the closely joined pair forms a purplish, perfect hemisphere. Although two females of a *Lasioptera* sp. were reared from the galls, most galls contained larvae of an unidentified gall midge of the supertribe Cecidomyiidi. A generally similar gall on an *Acacia* (q.v.) yielded a *Contarinia* sp. Host: *M. aculeaticarpa*. Distr.: Arizona, New Mexico.

Neltuma (mesquite)

1a Smooth, dehiscent flower bud gall, Plate 59 (13) ..... *Hemiasphondylia prosopidis* (Cockerell)

Six to eight generations of these galls develop between May and September. Galls consist of the aborted and enlarged ovary of the flower. They are smooth and pink to green,

monothalamous, thin-walled, conical and about 10 mm long by 5 mm in diameter. Each generation lasts 2-3 weeks. Galls dehisce at about the time adults are ready to emerge. Host: *N. glandulosa*. Distr.: Texas to Arizona. Rogers 1973.

1b Rough, persistent flower bud gall, Plate 59 (12) ..... *Asphondylia* sp.

Galls are brown, scaly and spindle-shaped, about 6 mm long by 2 mm wide. They are formed from the enlarged ovary and style of the flower atop a thickened peduncle. These galls develop in late April to early May and remain on the tree all year. Oviposition occurs in spring and the larvae remain in an early instar through the winter. Their main growth occurs the following spring. This species, unlike that in the abortive bud gall, is univoltine. Host: *N. glandulosa*. Distr.: Texas and New Mexico. Rogers 1973.

Olneya (desert ironwood)

Swollen leaflet, see Image 60 ..... *Contarinia* sp.

Affected leaflets resemble thin-walled bladders. Full-grown, orange larvae dropped out of the galls in late July. Adults emerged about a week later. Host: *O. tesota*. Distr.: Arizona.

Parkinsonia (paloverde)

Swollen, unopened, aborted flower, Plate 60 (1-2) or distorted pods .... *Asphondylia websteri* Felt and *Contarinia texana* Felt

A. websteri, alfalfa gall midge. Male and female flower parts are joined to form a smooth larval chamber. Adults pupate in the aborted flowers. Several generations occur per year. *Parkinsonia* is one of the native American hosts and reservoirs for this gall midge pest of alfalfa and guar. Hosts: *P. aculeata*, *P. florida* and *P. microphylla*; also *Cyamopsis tetragonoloba*, *Medicago sativa*, *Persea americana* (Lauraceae) and *Simmondsia chinensis* (Simmondsiaceae). Distr.: Oklahoma and Texas to California, also Honduras and Dominican Republic. Rogers 1972a, 1972b, Gagné and Wuensche 1986, Gagné and Woods 1988 and Hoddle 2008.

C. texana, guar midge. Larvae are gregarious and can be found throughout the year in flowers and pods. Adults drop to the ground to pupate. This species has several generations per year. Hosts: *P. aculeata*, *P. microphylla*; also *Cyamopsis tetragonoloba*. Distr.: Oklahoma to Mexico, west to Arizona. Rogers 1972b.

Phaseolus (bean)

Swollen, deformed pod ..... *Asphondylia* sp.

Larvae and pupae of this species are occasionally found in beans from Mexico intercepted at United States ports of entry. They fit the description for *Asphondylia websteri*, so may well be that species. Host: *Phaseolus* sp. (green beans). Distr.: Mexico and Guatemala.

Pithecellobium (blackbead)

Aborted, deformed seed pods ..... *Asphondylia* sp.

Adults emerged in May. Host: *P. keyense*. Distr.: Florida.

Psorothamnus (dalea, indigobush)

Succulent, yellow galls on petioles and leaves ..... *Dasineura* (s.l.) sp.

Galls are 3-4 mm in diameter, fleshy, round to ovoid and monothalamous. They may be detachable or integral to the leaf. Full-grown larvae were collected in early April. Host: *P. arborescens*. Distr.: California. Russo 2021.

Rhynchosia (snoutbean)

Atrophied or deformed pod, Plate 60 (9, 10) ..... *Asphondylia* sp.

Adults were reared in September from pods in various stages of development. Host: *R. senna*. Distr.: Texas.

Robinia (locust)

1a Hollowed-out petiole with symptomatic yellow leaves ..... *Resseliella* sp.

The petiole harbors gregarious orange-red larvae, leading to leaf-yellowing. Full-grown larvae were found in early July, promptly left the petiole, and adults emerged at the end of the month (J. van der Linden, in litt). Host: *R. pseudoacacia*. Distr.: Iowa.

1b Leaf deformations 2
2a Tightly folded, podlike swelling of leaflet, as on Plate 59 (14b) .....
..... *Dasineura pseudacaciae* Fitch)

The podlike swelling is similar to that shown for *Dasineura gleditchiae*. Larvae are gregarious and pupate in the galls. The species is multivoltine. It escaped into Europe with the horticultural trade. Host: *R. pseudoacacia*. Distr.: New York to Maryland and Europe.

2b Rolled margin of leaflet, Plate 59 (11) ..... *Obolodiplosis robiniae* (Haldemann)

Larvae are gregarious and pupate in the rolled margins. This species has at least two generations yearly. Host: *R. pseudoacacia*. Distr.: Maine to Florida; also accidentally introduced into Canada (British Columbia) and throughout Europe (Csóka et al. 2017), China, South Korea and Japan (Tokuda & Uechi 2021).

Senegalia (catclaw acacia)

1a Pairs of leaflets joined together, swollen at base, Plate 59 (9) …… *Contarinia* sp.

Each gall contains one larva. Adults were reared in March. Host: *S. greggii*. Distr.: California.

1b Bristly bud gall …… cecidomyiid

Buds bear monothalamous, green to rusty-brown clusters of 10 or more spheroid to tubular, 3-4 mm diameter galls covered with stiff bristles. Most galls were vacated by April 10. Host: S. greggii. Distr.: California. Russo 2021.

Tephrosia (hoary pea)

Folded leaflets …… cecidomyiid

Host: *T. virginiana*. Distr.: Massachusetts. Eiseman & Blyth 2022.

Thermopsis (goldenbanner)

Thickened, podlike terminal leaflet …… *Dasineura* sp.

Host: *T. rhombifolia*. Distr.: Colorado.

Trifolium (clover)

1a Leaflet folded and swollen along midvein, Plate 60 (12) …… *Dasineura trifolii* (Loew)

Clover leaf midge. Eggs are laid on developing leaflets. Larvae feed gregariously along the midrib covered by the expanding leaflet halves. Full-grown larvae spin a cocoon either in the swelling or in the soil. Several generations occur per year. This species is of European origin. Hosts: *T. pratense*, *T. repens*. Distr.: Massachusetts to Maryland, west to Nebraska; Europe. Barnes 1946b, Gagné & Strong 1993.

1b Aborted florets, Plate 60 (11) …… …… *Dasineura gentneri* Pritchard and *Dasineura leguminicola* (Lintner)

These two species from clover flowers are host specific and anatomically distinct. They cause a considerable reduction in seed production. Both were first discovered in the United States although they are immigrants from Europe. Eggs are laid on flower heads before the florets open. Larvae enter the developing florets and destroy the ovules. Full-grown larvae drop to the soil where they spin a cocoon. Several generations occur per year.

D. gentneri. Hosts: *T. repens*, *T. hybridum*. Distr.: widespread in North America; Europe. Bishop 1954.

D. leguminicola, Clover seed midge. Host: *T. pratense*. Distr.: widespread in North America; Europe. Barnes 1946b.

Vachellia (thorn tree)

1a Foreshortened, sterile pods …… *Asphondylia* sp.

Affected pods are bulbous, less than 1 cm long and taper to a curved point. Host: *V. pinetorum*. Distr.: Florida.

1b Short pinnule-shaped extension of plant organs …… cecidomyiid

The galls may appear on the stem, petiole, rachis or pinna. Each contains a single larva that feeds in an inconspicuous basal chamber surmounted by the pinnule extension. When fully grown the larva moves into the pinnule-like extension where it pupates. Host: *Vachellia* sp. Distr.: Chiapas. Liu & Bonfil 2001.

Vicia (vetch)

Leaflet rolled inwardly to form a tube …… *Dasineura* sp.

The rolled leaflet houses several gregarious larvae. When mature the larvae form cocoons in place in which they eventually pupate. Host: *V. lentoides*. Distr.: California.

Fagaceae

Castanea (chestnut)

1a Irregular swellings on burr, Plate 61 (1) …… "C*ecidomyia*" *chinquapin* Beutenmüller

Each swelling contains a single, orange-red larva that drops to the ground at the end of summer. Adults were not reared, so the generic status is still unknown, but larvae resemble somewhat those of *Arnoldiola castaneae* of entry 2a of this key. Host: *C. pumila*. Distr.: Virginia and North Carolina.

1b Bud or leaf galls …… 2
2a Enlarged, clustered buds, Plate 61 (2) …… *Arnoldiola castaneae* (Felt)

Reddish larvae were taken from galls in July to September and an adult was reared the following June. Host: *C. dentata*. Distr.: New York, West Virginia and North Carolina.

2b Leaf gall …… 3
3a Swollen petiole …… cecidomyiid

All that is known of this species is that it forms an irregular petiole swelling about 12 mm long (Felt 1940, 1965). Host: *C. pumila*. Distr.: unspecified.

3b Circular, rough blister or eruption on lamina or leaf fold 4
4a Circular blister or eruption, usually between veins 5
4b Leaf or vein fold 6
5a Roughened blister on lower leaf surface, Plate 61 (3e) ..... cecidomyiid

Galls are small, 2-3 mm in diameter, evident on the underside of the leaf as a warty blister, on the upper side as a smooth convexity. The surface of the gall on the underside eventually dehisces as a cap to reveal a single larva in a smooth, craterlike depression, after which the larva presumably drops to the ground. The gall was originally and subsequently attributed to an eriophyid mite (Stebbins 1910, Jarvis 1909, Felt 1918a, 1940, 1965). Larvae I have seen cannot be assigned to any available genus. Host: *C. dentata*. Distr: Massachusetts, Ontario and Ohio.

5b Conical eruption on lower leaf surface ..... *Contarinia* sp.

Galls are minute, ca 2 mm in diameter. On the underside of the leaf the galls are conical, about 2 mm high, with hairs surrounding the apex that eventually opens to allow the larvae to escape. On the upper side of the leaf the galls show as simple convexities. Each gall has a single larva that is c-shaped by the time it is full-grown. Host: *C. pumila*. Distr.: Georgia.

6a Fold between and sometimes across veins, without conspicuous invagination on opposite side of leaf, Plate 61 (3b, 4b) ..... *Contarinia* sp.

These galls distort leaves as they are unfolding in early spring. The narrow, longitudinal or diagonal folds of one to several cm in length project out of the upper side of the leaf, contrary to those of the two *Harmandiola* spp. in the following couplet that project outwards from the underside of the leaf. In early spring full-grown larvae escape through the longitudinal slit on the lower side of the leaf. Host: *C. dentata*. Distr.: Maryland and Georgia.

6b Fold along vein with conspicuous cylindrical or bulbous enlargement on lower side of leaf ... 7
7a Smooth, globular fold, Plate 61 (3a, 4a) ..... *Harmandiola castaneae* (Stebbins)

Galls develop in spring. In June and July larvae escape through the elongate opening that develops along the vein on the upper surface of the leaf and burrow in the soil. Probably only one generation occurs per year. Hosts: *C. dentata*, *C. pumila*. Distr.: Massachusetts and New York to North Carolina. Gagné and Payne 1992b.

7b Rough, ribbed, usually elongate fold, Plate 61 (3d) ..... *Harmandiola amisae* Gagné

Galls are evident immediately after the leaves have expanded in spring. Each fold may harbor one to several larvae. In mid to late spring, the full-grown white larvae escape to the soil through a slit that develops along the upper surface of the leaves. Larvae remain in the soil until the following spring. Severely infested leaves may drop prematurely after the larvae

leave. Hosts: *C. dentata*, *C. pumila*. Distr.: Massachusetts and New York to Georgia. Gagné and Payne 1992b.

Chrysolepis (chinquapin)

Vein swelling or rolled leaf …… cecidomyiid

Nothing further is known of this gall beyond Felt's (1940, 1965) original record. Host: *Chrysolepis* sp. Distr.: western United States.

Fagus (beech)

In buds …… *Contarinia* sp.

Larvae were found between bud scales in April in Pennsylvania and taken from buds in October in North Carolina. Host: *Fagus grandifolia*. Distr: Pennsylvania, North Carolina.

Notholithocarpus (tanoak)

Spheroid catkin gall …… cecidomyiid

Galls are about 5 mm in diameter and covered with dense, appressed, tan pubescence. Several may occur along the length of a catkin. Separate larval chambers, each with a white larva, are topped by fleshy projections on the gall periphery. The gall maker is an unidentified species of Lasiopteridi. Host: *N. densiflorus*. Distr.: northern California. Russo 2021.

Quercus (oak)

Most galls found on oaks are made by wasps of the subfamily Cynipinae (Hymenoptera: Cynipidae), which are beyond the province of this book. Gall midges are nonetheless well-represented. They mostly belong to two Holarctic genera, *Macrodiplosis* and *Polystepha*, both restricted to oaks. Neither has undergone comprehensive study, a reason the following key has little new about them. *Macrodiplosis* species cause extensive leaf roll and vein fold galls on white and red oaks in eastern North America. Galls develop in spring when their often gregarious, white larvae develop quickly and soon drop to the soil where they remain through the winter. Galls of *Polystepha*, by contrast, are usually one-chambered spot, blister or pill galls on leaves and only occasionally other organs of red oaks. Galls are evident from mid-summer to early fall. Several galls may occasionally coalesce, but larvae remain in individual chambers. Galls develop slowly and the usually orange larvae reach their full size in late summer or autumn. Larvae of some *Polystepha* species overwinter in their galls, others exit in the fall and form cocoons in the soil. Some kinds of Polystepha galls can be seen on many species of oak, but it is not known whether similar galls are all made by the same species of gall midge. Because the galls of some species were not always clearly described initially, the following key lists for most gall midge species only the type host and type locality. These species are all doubtless more widespread, but it will take more than a piecemeal approach to appreciate their diversity.

Also on oaks are a group of *Lasioptera* that are secondary inhabitants of blossom, twig and

petiole galls initiated by cynipine wasps. These gall midges are called successor species because they are found in galls after the wasps causing the galls have exited. Pupation takes place inside the galls. A characteristic of this group of *Lasioptera* is the unusually large number of adult antennal flagellomeres and the remarkably long larval setae. These are not in the key that follows, but the four named species and their original niche and locality are: *Lasioptera howardi* Felt from twig galls in California, *Lasioptera querciflorae* Felt from an unspecified oak blossom gall in Arizona, *Lasioptera querciperda* Felt from twig galls in Virginia and *Lasioptera quercirami* Felt from twig galls in Utah. Subsequent collections of these species reared from cynipine galls show that some are not restricted to particular cynipine galls. *Lasioptera querciflorae* has additionally been reared from twig galls on *Q. alba* in Ontario, twig galls on Q. phellos in Maryland and empty leaf galls of the cynipid *Bassettia ligni* Kinsey on *Q. garryana* in Oregon. *Lasioptera querciperda* Felt is known also from leaf midrib and petiole galls of bur oak and red oak in New York and Connecticut. An unidentified *Lasioptera* was found in galls on *Quercus douglasii* that was probably made by the cynipid *Neuroterus fragilis* Bassett in California. The same galls produced another inquilinous cecidomyiid of the genus *Camptoneuromyia*.

Oaks are also host to various species of the large genera *Dasineura* and *Contarinia*, Some of them are gall makers, others are inquilines in *Macrodiplosis* leaf galls. One or more species of an unknown genus near *Dasineura* form a peculiar invagination of the leaf margin of several oaks in western North America (Plate 61 (2). *Dasineura florida* Felt, originally described as reared from an “oak-like gall" resembling that of a *Polystepha*, was subsequently listed as responsible for an undetermined oak gall (Felt 1940, 1965). Notes relating to that species in the USNM indicate that the host was unknown, so *D. florida* is not considered further here. *Dasineura* females were reared from simple leaf spots on *Q. rubra* in Michigan (Eiseman 2025a). The gall of *Macrodiplosis qoruca* Felt was once attributed to *Parallelodiplosis florida* Felt. The latter species may be a fatal inquiline in the galls (see, e.g., Gagné & Moser 2012).

1a Larvae associated with acorns, flowers or buds …… 2
1b Larvae in leaves or green stem galls …… 6
2a Larvae associated with acorns …… 3
2b Larvae in catkins, aborted buds or bud galls …… 4
3a Larva under seed coat …… *Dasineura glandis* Felt

No further details are known of the biology of this species. Host: *Quercus* sp. Distr.: Missouri.

3b Larvae under cap …… cecidomyiids

A variety of larvae can be found in this niche, including the sometimes mycophagous *Clinodiplosis*, predaceous *Lestodiplosis*, even *mycophagous Porricondyla* of the subfamily Porricondylinae. Hosts: *Quercus* spp. Distr.: widespread.

4a Larvae in catkins …… *Contarinia* sp.

The specific damage to the catkins made by this undescribed species is unknown, but in spring the full-grown yellow larvae can be numerous enough to cover the surface of the ground beneath the tree until they have dug into the soil. The larvae presumably remain there

until the following spring. Host: *Q. palustris*. Distr.: Maryland.

4b Larvae under bud scales or in aggregates of rosette galls 5
5a Larvae under bud scales ..... *Contarinia* sp.

Larvae were taken from among imbricated bud scales in early June. Host: *Q. rubra*. Distr.: New York.

5b Larvae in spheroidal aggregates of aborted buds, see Image 61 ..... *Arnoldiola atra* Gagné

Aggregate bud masses may reach 2.5 cm in diameter. Each aborted bud forming the mass is a closed rosette made up of many wide bracts among which are found larvae that overwinter there in cocoons. Host: *Quercus virginiana*. Distr.: Texas, Florida. Gagné & Riley 1999.

6a Larva in green twigs or petioles 7
6b Larva in the leaf lamina 8
7a Larva in twig, see Image 62 ..... presumed *Polystepha* sp.

A single larva was found in July in a twig presenting minor swelling. Host: *Quercus* sp. (a red oak). Distribution: Iowa.

7b Larva in swollen petiole, see Image 63 ..... presumed *Polystepha* sp.

Larvae were found singly in swollen petioles. Host: *Quercus* sp. (a red oak). Distribution: Iowa.

8a Circular, flat, hemispherical or elongate closed gall ..... *Polystepha* spp. 9
8b Leaf fold, always with a slitlike opening 14
9a Thin-walled, elongate blister on leaf vein, Plate 62 (1d) .....
..... *Polystepha americana* (Felt) and *Polystepha podagrae* (Felt)

P. americana. This species lives in slight swellings of lateral veins, nearly the same color as the leaf. Host: *Q. rubra*. Distr.: New York.

P. podagrae. This species is from purplish blisters, about 8 mm long, on the underside of mid or lateral veins. Host: *Q. velutina*. Distr.: Massachusetts.

9b Circular, flat or convex chamber between veins 10
10a Rough, convex, thick-walled, brown gall, several often coalesced 11
10b Smooth, flat or convex, thin-walled gall 12
11a Gall equally prominent on both sides of leaf, outer surface peeling away at end of season, Plate 62 (1f) ..... *Polystepha symmetrica* (Osten Sacken)

It is possible that this species is also responsible for the gall on Plate 62 (1b). Host: *Q. falcata*. Distr.: Maryland.

11b Gall evident only on upper side of leaf, outer surface not dehiscent, Plate 62 (1e) .... *Polystepha pilulae* (Beutenmüller)

This is one of the most conspicuous *Polystepha* galls and is commonly seen in autumn on many kinds of red oaks. Hosts: *Quercus* spp. Distr.: Massachusetts, New York.

12a Spherical gall, Plate 62 (1b) ..... *Polystepha globosa* (Felt)

This gall is usually found on the lower side of leaves. Host: *Q. velutina*. Distr.: Massachusetts.

12b Flat and inconspicuous or slightly raised blisters 13

13a Gall not raised above surrounding leaf tissue, Plate 62 (1a) ... *Polystepha quercifolia* (Felt)

Often accompanied by reddish discoloration, the gall is otherwise inconspicuous. Host: *Q. rubra*. Distr.: Maryland.

13b Gall protruding from both surfaces of leaf, Plate 62 (1c) ..... *Polystepha pustulata* (Felt), *P. pustuloides* (Beutenmüller), *P. serrata* (Felt), *P. simpla* (Felt) and *P. sobrina* (Felt)

Some of the five species in this half-couplet may be synonyms.

P. pustulata. Host: *Q. velutina*. Distr.: Massachusetts.

P. pustuloides. Hosts: *Quercus* spp. Distr.: New Jersey and North Carolina.

P. serrata. A photo in Felt (1940, 1965) shows a central nipple on this gall. Host: *Q. coccinea*. Distr.: Massachusetts.

P. simpla. Host: *Q. velutina*. Distr.: Massachusetts.

P. sobrina. This gall shows mostly on the upper leaf surface. Host: *Q. velutina*. Distr.: Massachusetts.

14a Galls found in eastern or midwestern North America 15

14b Galls found in western North America 19

15a Folded sinus, usually green, tinged with red, Plate 63 (3d) .... *Macrodiplosis erubescens* (Osten Sacken) and *Contarinia* sp.

M. erubescens. Host: *Quercus* sp., ``red oak." Distr.: Maryland.

Contarinia sp. Sinus galls yielded larvae that were heavily parasitized by a mite, *Pyemotes herfsi* (Oudemans) (Acari: Pyemotidae). The mites were implicated as the cause of severe bite outbreaks on humans and other animals (Broce et al. 2006). Host: *Q. palustris*. Distr.: Kansas.

15b Leaf folded along or between veins 16
16a Short, pea-sized pouch gall on underside of leaf blade, usually near leaf vein, thin-walled, pale green to reddish, Plate 63 (3b) ..... *Macrodiplosis majalis* (Osten Sacken)

Host: *Q. palustris*. Distr.: Maryland.

16b Elongate vein fold 17
17a Amorphous, thin-walled, large fold with white down on inside surface, the leaf often deformed, Plate 63 (1) ..... *Macrodiplosis niveipila* (Osten Sacken)

Host: *Q. alba*. Distr.: Maryland.

17b Regular, narrow, thick-walled, more or less annulate vein fold 18
18a Vein fold parallel sided, smooth, usually longer than 1 cm, Plate 63 (3e) ..... *Macrodiplosis qoruca* (Walsh)

Host: *Quercus* sp. Distr.: Illinois.

18b Vein fold tapered, striate, usually about 5 mm long, Plate 63 (3c) ..... *Contarinia* sp.

Larvae drop to the soil in summer and remain in that stage until the following spring. Host: *Q. palustris*. Distr.: Maryland.

19a Folded, thickened lobe along leaf edge, Plate 62 (2) ..... "*Dasineura*" *silvestrii* Trotter

The galls are better described as pouches rather than marginal folds because the leaf edge is somewhat extended. Only larvae are known; they belong to the Lasiopteridi but have not been assigned to a genus. They pupate in the galls. Several species may be included under this rubric, including one illustrated in Russo 2021. Hosts: *Q. chrysolepis*, *Q. garryana*, *Q. vaccinifolia*. Distr.: Oregon and California. Russo 2021.

19b Elongate, marginal leaf roll, Plate 63 (2) ..... *Contarinia* sp.

In summer larvae drop to the soil where they overwinter. Host: *Q. vaccinifolia*. Distr.: Oregon. Russo 2021.

Fouquieriaceae

Fouquieria (ocotillo)

In unopened aborted flower, see Image 64 ..... *Asphondylia* sp.

Adults emerged in early November, one per aborted flower. Host: *F. splendens*. Distr.: Texas. Eiseman 2025a.

Garryaceae

Garrya (silktassel)

Globular, fleshy galls of axillary buds and catkins, Plate 57 (4) …… *Asphondylia garryae* Felt

Galls are conspicuous, up to 18 mm long by 14 mm diameter, soft, spongy and formed of greatly expanded, overlapping bud scales. Each contains a single larva, but individual galls may coalesce. Galls are apparent in early summer and adults emerge from them in spring. Hosts: *G. buxifolia*, *G. fremontii*. Distr.: Oregon and California. Russo 2021.

Gentianaceae

Gentiana (gentian)

In tubular, closed corollas …… *Neolasioptera* sp.

Galls were found in October. Host: *G. andrewsii*. Distr.: Pennsylvania.

Geraniaceae

Stem blisters on *Geranium* were attributed to a cecidomyiid in Felt (1940, 1965). Larvae in his collection associated with that damage belong to *Mycodiplosis*, a genus that feeds exclusively on fungi, mainly rusts. The blister in this case may have been formed by a rust.

Grossulariaceae

Ribes (currant, gooseberry)

"*Mayetiola" californica* Felt, not presently placed to genus, was described from specimens reared from *Ribes menziesii* in Alameda, California, but the gall or other damage was not originally specified (Felt 1915c). Felt (1940, 1965) later indicated that it was "probably [from a] leaf gall." The syntypes bear the number 379, referring to the original collector's (A. Koebele) notes that are maintained in a card file in the USNM. The specimens were reared on "Feb. 13 from tips of last year's growth." This would indicate a bud gall; in fact, the type series shows some similarity to *Rhopalomyia grossulariae* Felt in couplet 3a below, although the two species are distinct.

A gall midge found on *Ribes* in Iowa but not keyed below is an unidentified species of *Clinodiplosis*, evidently a secondary feeder found in association with a lepidopteran cambium miner, *Opostegoides scioterma* (Lepidoptera: Opostegidae) (John van der Linden, in litt.).

1a Enlarged, deformed fruit …… cecidomyiid

Infested fruit become enlarged but drop earlier than normal. The gall maker is known only from larvae, which cannot yet be placed to genus. "*Cecidomyia" grossulariae* Fitch was reared from yellow larvae taken from rotten gooseberries, but the single female reared from them is possibly a *Hyperdiplosis* and unlikely to be the gall maker. Fitch (1855) reported the damage from both cultivated and wild gooseberries. Host: *R. uva-crispa*, *Ribes* sp. Distr.: Montana, Wyoming and New York.

1b On other plant parts 2
2a Swollen, aborted flowers ..... cecidomyiid

Larvae, probably either *Contarinia* or *Dasineura* (not seen), are white and drop to the soil when full-grown. The affected flowers die and drop off soon after the larvae depart. Host. *Ribes* sp. Distr.: California.

2b On buds, leaves or stems 3
3a Enlarged, deformed bud or cluster of buds, Plate 94 (5) ..... *Rhopalomyia grossulariae* Felt

Adults appear in May and lay eggs on new buds. Bud scales increase greatly in size and number to form a cylindrical elongated bud, at least in eastern U.S. Russo (2021, plate 451) shows a gall with the bud leaves flared outwardly; it is identified there as *Rhopalomyia* sp. and may be this species. In the original discovery by Houser (1912), galls were found in large clusters and killed the affected branches, if not outright, then subsequently. Full-grown, deep-red larvae overwintered in a chamber at the very base of a bud among tightly closed scale leaves. Pupation occurred in spring and adults emerged in May. That this species was found on an introduced plant begs the question of whether the insect could be an introduction, but no similar damage has been reported on that host from Europe (Roskam 2019, Skuhravá and Skuhravý 2021). Host: *R. uva-crispa* (as *grossularia*), *Ribes* spp. Distr.: Oregon, California, Montana, Wisconsin, Ohio, Delaware. Houser 1912, Russo 2021.

3b Stem or leaf galls 4
4a Irregular stem swelling ..... *Neolasioptera* sp.

The gall, reportedly about 2 cm long and 1 cm in diameter (Felt 1940, 1965), was attributed to "*Cecidomyia* sp." A series of adults in the USNM from "currant" in Washington belong to *Neolasioptera* and may be the item reported by Felt. Host: *Ribes* sp. Distr.: Washington.

4b Leaf galls 5
5a Leaf blister, see Image 65 ..... *Ribesia sarae* Gagné

Blisters, about 3 mm in diameter, are commonly found several to a leaf. Larvae exit from a slit on the underside of the leaf in mid-July and overwinter in the soil. Hosts: *R. inerme* and *R. aureum*. Distr.: Montana, Colorado. Gagné 2016b.

5b Midrib fold ..... *Dasineura* sp.

Leaves are distorted and folded inwardly, their veins swollen. Larvae pupate in the folds and

emerge in late spring through openings along the length of the fold. Host: *R. sanguineum*. Distr.: California. Russo 2021.

Hamamelidaceae

Hamamelis (witch-hazel)

Larvae of the two *Contarinia* spp. in the key that follows are distinct, but adults of neither have yet been reared. Not keyed here, but the spinelike leaf galls formed by *Hormaphis hamamelidis* Fitch (Hemiptera: Aphididae) on witch-hazel yielded three cecidomyiids, the predators, *Aphidoletes aphidimyza* (Rondani) and a *Lestodiplosis* sp., and a presumably fungivorous *Clinodiplosis* sp.

1a Circular leaf blister, Plate 77 (4a) …… *Contarinia* sp.

Each spot contains a white larva that when fully grown exits through a slit in the leaf surface. Host: *H. virginiana*. Distr.: Massachusetts and Maryland.

1b Vein fold, Plate 77 (4b) …… *Contarinia* sp.

Folds are 1-3 cm long and found in spring. Larvae are white and drop to the soil when full-grown. A female cecidomyiid was reared from "wrinkled, discolored, intervenal folds" from New York (Felt 1940, 1965) but that specimen is a predator belonging to *Lestodiplosis*. Host: *H. virginiana*. Distr.: Massachusetts and Connecticut. Wells 1914, Eiseman 2025a.

Hydrangeaceae

Fendlera (fendlerbush)

Enlarged, woody bud …… cecidomyiid

Infested buds are woody, with a central chamber inhabited by several larvae. Only early-instar larvae are known, so this species could not be identified further. Host: *F. rupicola*. Distr.: Arizona.

Hydrangea (hydrangea)

Enlarged bud, Plate 94 (6) …… *Asphondylia hydrangeae* Felt

Infested apical bud galls found in spring are monothalamous and about 1 cm long by 1 cm in diameter. Adults emerge from the buds in spring and eggs are laid in the next year's buds at the base of the plant. Two generations occur per year. Host: *H. arborescens*. Distr.: Maryland, Virginia and Missouri.

Hypericaceae

Hypericum (St. John's wort)

In addition to the two species in the key below, a series of *Clinodiplosis* sp. was reared in August in Massachusetts from sprigs of *Hypericum mutilum* collected in mass to rear a lepidopterous leaf miner.

1a Irregular stem swelling, Plate 77 (5) ..... *Neolasioptera triadenii* (Beutenmüller)

Swellings are about 8-12 mm long and monothalamous. The orange larvae overwinter in the stems where they pupate the following spring. Host: *H. virginicum*. Distr.: Massachusetts, New York and New Jersey.

1b Swollen seed capsule or bud 2
2a Enlarged seed capsule ..... *Dasineura toweri* Felt

Infested seed capsules are about 5 mm long and 3 mm in diameter. Adults were reared in early fall. Host: *H. mutilum*. Distr.: Massachusetts.

2b Swollen bud, Plate 77 (6) ..... *Zeuxidiplosis giardi* (Kieffer)

Buds are ovoid and slightly pointed at the tip, the terminal leaves incurved, swollen and usually red. Larvae may be gregarious and pupate in situ. The species is multivoltine. It was introduced from Europe into California for the control of the alien *Hypericum perforatum*, but has apparently crossed over to a native American *Hypericum*. Hosts: *H. perforatum*, *H. concinnum*. Distr.: California. Also, widespread Europe and an immigrant in Australia, New Zealand and South Africa. Barnes 1952, Harris 1966, Gordon & Neser 1986.

Juglandaceae

Carya (hickories, pecan)

Sixty-three species of cecidomyiids are known from hickories. Fifty-six of them belong to *Caryomyia* and cause complex, dehiscent leaf galls, usually on the underside of the leaflets (Plates 65-75). Two of these species dehisce early in spring but the remainder may be found through the summer and autumn when they either dehisce separately or drop with the leaves. All *Caryomyia* larvae remain in the galls through winter and pupate in early spring. Adults emerge to lay eggs on fresh leaves from March to early May. Six species in four other genera are responsible for simple galls on leaflets, petioles, or nut husks (Plates 75-76). The one remaining species, not keyed below, is *Parallelodiplosis caryae*, a common inquiline in galls of *Caryomyia* spp. and hickory-feeding *Phylloxera* spp. (Phylloxeridae: Hemiptera). The gall midges of hickories are mostly specific to hickory sections *Eucarya* and *Apocarya*, but no specificity is apparent on particular species within a section. Most *Caryomyia* species live on the Eucarya section. *Phylloxera* spp. also form many kinds of galls on hickory and pecan leaflets. These become apparent mainly in spring and can be

distinguished externally from most cecidomyiid galls by the conspicuous opening on one surface of the leaflet or petiole and internally by the presence of aphid-like insects with legs, as shown on Plate 64 (1m). For more information on the cecidomyiids listed below, see the monograph by Gagné (2008).

Caryomyia galls are best keyed still attached to the leaflets because their position on the leaf and the presence of any surrounding leaf exfoliation are useful identifying characters. Some galls may need to be cut open to see their internal structure. For this key as well as in the illustrations, *Caryomyia* galls are oriented with their apex upwards without regard to which leaf surface they normally occur on.

1a Discolored, sticky leaf spot with exposed larva, Plates 64 (1g), 76 (7-9) ..... *Gliaspilota glutinosa* (Osten Sacken)

Hickory sticky leaf spot. Fresh galls are found in May and June. Full-grown larvae, one to several on each spot, drop to the soil when full-grown. Hosts: *Carya* spp., both sections. Distr.: eastern North America.

1b Simple or complex leaf gall or nut husk swelling, with enclosed larva 2
2a Gall a simple, integral swelling of petiole, leaflet, or nut husk 3
2b Gall complex, on leaflet 6
3a Hemispherical swelling of nut husk, Plates 64 (2), 76 (10-12) .... *Harmandiola nucicola* (Osten Sacken)

Hickory husk swelling. The single larva in each swelling digs its way out of the still green husks in late summer and overwinters in the soil. Hosts: *Carya* spp., both sections. Distr: eastern North America.

3b Swelling of petiole or leaflet 4
4a Circular, biconvex swelling of lamina, Plates 64 (1c), 75 (11-12), 76 (1) .... *Caryadiplosis biconvexa* Gagné

Hickory convex leaf swelling. Swellings each contain a single larva that drops to the ground when mature. Hosts: *Carya* spp., both sections. Distr.: eastern North America.

4b Swelling of petiole, leaf vein or lamina 5
5a Hard, elongate swelling of petiole or leaf vein, Plate 75 (9-10) … *Caryadiplosis venicola* Gagné

Hickory midrib swelling. Galls contain one or more larvae, each in a separate chamber. Full-grown larvae drop to the soil when mature. Hosts: *Carya* spp., both sections. Distr.: eastern North America.

5b Soft, bubble-like swelling of lamina, Plate 76 (2-3) ..... *Contarinia bulliformis* Gagné

Hickory leaf bubble. Larvae drop to the soil when full-grown. Host: *Carya illinoiensis* (pecan). Distr.: Texas.

6a Gall decumbent, main axis parallel or nearly parallel to leaflet 7
6b Gall perpendicular to leaflet or only slightly leaning (Figs. 36, 145, 147) 12
7a Gall apex convex; eventual exit apparent on opposite leaf surface; indehiscent, Plate 76 (4-6) ... . *Contarinia cucumata* Gagné

Hickory cucumber gall. Galls are commonly found in May and June, after which full-grown larvae exit to drop to the soil. Hosts: *Carya* spp., both sections. Distr.: eastern North America.

7b Gall apex pointed; without apparent exit hole on opposite leaf surface; dehiscent 8
8a Gall abruptly narrowed before apex 9
8b Gall gradually narrowed from base to apex 10
9a Gall surface rough, with sparse hair, Plate 69 (5-6) ..... *Caryomyia eumaris* Gagné

Hickory Persian shoe gall. Galls are attached to the smaller veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

9b Gall surface smooth, hairless, Plate 69 (7-8) ..... *Caryomyia recurvata* Gagné

Hickory smooth squash gall. Galls are attached to the smaller veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

10a Gall hairless; base not bulbous, flattened against leaf surface, Plate 70 (1-2) .... *Caryomyia supina* Gagné

Hickory supine squash gall. Galls occur on veins on the lower surface of the leaflets. Hosts: *Carya* spp., both sections. Distr.: eastern North America.

10b Gall hairy; base bulbous 11
11a Gall hair long, crinkly, Plate 69 (9-10) ..... *Caryomyia spinulosa* Gagné

Hickory thorn gall. Galls occur along veins on the lower surface of the leaflets. Host: *Carya cordiformis*. Distr.: eastern North America.

11b Gall hair short, straight, Plate 69 (11-12) ..... *Caryomyia procumbens* Gagné

Hickory hairy squash gall. Galls occur on veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America, but not east of the Appalachians except for New England.

12a Gall surface hairy, the hair thick or sparse 13
12b Gall surface hairless except for possible tuft of sparse short hair at extreme apex 37
13a Gall with partial or complete false chamber above larval chamber 14
13b Gall without false chamber 15
14a Gall a depressed spheroid, twice as wide as long, densely covered with flat, decumbent hair; false chamber closed, Plate 70 (9-10) ..... *Caryomyia tumida* Gagné

Hickory frosted gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

14b Gall upstanding, as long as wide, sparsely covered with erect hair; false chamber open apically, Plates 64 (1k), 70 (3-4) ..... *Caryomyia inanis* Felt

Hickory papery gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America, but not east of the Appalachians except in New England.

15a Gall flattened, discoid, stellate (Figs. 100-101) ..... *Caryomyia asteris* Gagné

Hickory starburst gall. Galls occur between veins on the lower side of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America, but not east of the Appalachians or Ohio, except along the South Carolina coast.

15b Gall elongate or spheroidal, not stellate 16
16a Gall wall almost uniformly thin, brittle, of same shape as larval chamber 17
16b Gall wall thick, soft or woody, extraneous to shape of ovoid larval chamber 23
17a Gall elongate-conical, gradually narrowed from base to apex; hair as long as gall diameter; dehiscing in spring of same year as inception, Plate 65 (6-7) … *Caryomyia albipilosa* Gagné

Hickory white-haired gall. Galls of this species and *C. striolata* are the only two on hickory that develop quickly and dehisce in spring instead of later in the season. Galls occur between veins on the underside of leaflets. Hosts: *Carya* spp., both sections. Distr.: eastern North America.

17b Gall spheroidal; hair not half as long as gall diameter; dehiscing in summer/fall 18
18a Gall apex with dimple; larval chamber with intrusion of hair from apex, Plates 64 (1j), 71 (5-8) ..... *Caryomyia thompsoni* Felt

Hickory placenta gall. Galls occur between veins on the lower surface of the leaflets. Galls of this species exhibit considerable variation. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

18b Gall apex without dimple; larval chamber without intrusion of hair from apex 19
19a Gall hair thick, obscuring surface 20
19b Gall hair sparse, not obscuring surface 21
20a Gall apex with tuft of hair thicker and longer than remaining hair, the tuft covering circular, apical, thin areola, Plate 66 (2-3) ..... *Caryomyia hirtidolium* Gagné

Hickory hairy ginger jar gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

20b Gall hair uniformly distributed; surface texture uniform, Plate 66 (6-7) ..... *Caryomyia hirtiglobus* Gagné

Hickory woody globe gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

21a Gall connection to leaf a deep, circular depression; apex with circular, thin areola surrounding nipple; on bitternut, Plate 66 (4-5) ..... *Caryomyia cilidolium* Gagné

Hickory fuzzy ginger jar gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya cordiformis*. Distr.: eastern North America.

21b Gall connection to leaf conical; apical texture uniform except for nipple; on *Eucarya* section 22

22a Gall with prominent apical nipple; hair brown, stiff, erect, Plate 67 (5-6) ..... *Caryomyia spiniglobus* Gagné

Hickory spiny ball gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

22b Gall with slight apical nipple; hair white, soft, decumbent, Plate 67 (7-8) ..... *Caryomyia deflexipili* Gagné

Hickory reflexed hair gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America, but not east of the Appalachians, except for New England and the Georgia Piedmont.

23a Larval chamber with conspicuous tuft of hair intruding apically, Plates 64 (1b), 71 (9-10) ..... *Caryomyia holotricha* Gagné

Hickory hairy gumdrop gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

23b Larval chamber without intrusion of hair 24

24a Gall obconic, apex flattened; hair appreciably thicker and darker at apex than elsewhere, Plate 72 (3-5) ..... *Caryomyia turbinata* Gagné

Hickory top-shaped gall. Galls occur between veins on the upper surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

24b Gall spheroidal or widest near base or middle; hair uniformly distributed throughout or thicker at base 25

25a Gall on upper leaf surface; bulbous base smooth and hairy, conical apex bumpy and nearly hairless, Plates 72 (12), 73 (1) ..... *Caryomyia turbanella* Gagné

Hickory turban gall. Galls occur on veins on the upper surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

25b Gall on lower leaf surface; not conspicuously bumpy apically, uniformly hairy throughout 26
26a Gall surface smooth, easily visible through sparse hair 27
26b Gall surface rough and/or covered with resinous dots, the hair usually thick 28
27a Gall spheroidal at base, becoming conical, Plate 73 (5-6) ..... *Caryomyia conoidea* Gagné

Hickory fuzzy gumdrop gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

27b Gall discoid at base, narrowed abruptly beyond, Plate 73 (7-8) … *Caryomyia marginata* Gagné

Hickory marginate gall. Galls occur between or on veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America, but not east of the Appalachians except in New England.

28a Gall narrowed abruptly from large base; apex digitate 29
28b Gall spheroidal or conical and narrowed gradually; apex not digitate 32
29a Gall leaning, base variously lobed, Plate 74 (1-2) ..... *Caryomyia inclinata* Gagné

Hickory inclined gall. Galls occur along veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America, but not east of the Appalachians except in New England.

29b Gall upright, base evenly spherical 30
30a Gall on lamina; some hairs stiff and as long as gall diameter, Plate 74 (8-9) ..... *Caryomyia echinata* Gagné

Hickory spiny gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America but not east of the Appalachians.

30b Gall on or adjacent to veins; hair bowed, less than half gall diameter 31
31a Gall surface with dark, resinous dots; on *Eucarya* section, Plate 74 (5-7) ..... *Caryomyia cucurbitata* Gagné

Hickory pumpkin gall. Galls occur along veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

31b Gall surface without resinous dots; on *Apocarya* section, Plate 74 (3-4) ..... *Caryomyia ansericollum* Gagné

Hickory gooseneck gall. Galls are usually closely set along veins on the underside of the leaflets. Host: *Carya cordiformis*. Distr.: eastern North America.

32a Gall surface visible through hair 33
32b Gall surface not visible through hair 34
33a Gall base with convex connection to leaf; surface smooth, hair extensive, Plate 75 (2-3) .....

…… *Caryomyia antennata* Gagné

Hickory spindle gall. Galls occur along veins on the underside of leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

33b Gall base with circular, concave depression; surface rough, covered with resinous dots, hair sparse, Plate 74 (10-11) …… *Caryomyia guttata* Gagné

Hickory teardrop gall. Galls are usually in rows along veins and occasionally on the rachis on the underside of leaves. Hosts: *Carya floridana*. Distr.: Florida.

34a Gall on lamina; base with deep, circular, central depression; larval chamber usually purple, Plates 71 (13), 72 (1-2) …… *Caryomyia purpurea* Gagné

Hickory purple gumdrop gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

34b Gall on or closely adjacent to leaf vein; base without central depression; larval chamber green or brown …… 35

35a Gall unevenly spheroidal, usually found closely compressed into groups; larval chamber irregularly ovoid, Plates 74 (12), 75 (1) ……*Caryomyia aggregata* Gagné

Hickory aggregate gall. Galls occur along veins in tight, often coalesced rows on the underside of leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

35b Gall spherical to conical, always discrete; larval chamber ovoid …… 36

36a Gall spherical, woody; larval chamber at center of gall, Plate 75 (4-5) …… …… *Caryomyia spherica* Gagné

Hickory spherical woody gall. Galls occur on veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

36b Gall spheroidal or conical, soft, the apex eventually shrinking somewhat; larval chamber at base of gall, Plates 64 (1d), 72 (6-9) …… *Caryomyia persicoides* (Osten Sacken)

Hickory peach-haired gall. Galls occur on veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

37a Gall surface sticky to touch …… 38

37b Gall surface not sticky …… 44

38a Gall sheathed at base by conspicuous leaf exfoliation …… 39

38b Gall not sheathed at base by conspicuous leaf exfoliation …… 40

39a Gall spherical, rubbery; larval chamber surrounded laterally and above by large, false chamber, Plate 70 (11-12) …… *Caryomyia lenta* Gagné

Hickory popover gall. Galls occur between veins on the lower surface of the leaflets. Hosts:

Carya (*Eucarya*) spp. Distr.: eastern North America, but not east of the Appalachians except in New England.

39b Gall short-cylindrical, hard; without false chamber, Plate 68 (11-12) ..... *Caryomyia melicrustum* Gagné

Hickory honey tart gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

40a Gall with apical nipple surrounded by large areola 41
40b Gall surface uniform or concave or with simple umbo at apex 42
41a Gall surface bumpy, conspicuously covered with resin glands; usually on under surface of leaflet, Plates 65 (13-14), 66 (1) ..... *Caryomyia tuberidolium* Gagné

Hickory bumpy ginger jar gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

41b Gall surface smooth, with sparse resin glands; on upper surface of leaflet, Plate 65 (10-12) ..... *Caryomyia viscidolium* Gagné

Hickory sticky ginger jar gall. Galls occur between veins on the upper surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

42a Gall surface bumpy; base with deep, circular, central impression, Plate 71 (11-12) ..... *Caryomyia tuberculata* Gagné

Hickory bumpy woody gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

42b Gall surface smooth except for minute resin glands; base conical 43
43a Gall spheroidal, apex convex; surface smooth, hard, brittle, Plates 64 (11), 66 (8-11) ..... *Caryomyia caryae* (Osten Sacken)

Hickory sticky globe gall. Galls exhibit some variation in shape; they occur between veins on the lower side of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

43b Gall short-cylindrical, apex concave; corona surrounding concavity soft at first, later contracting and forming rough, brown crust, Plate 68 (7-10) ..... *Caryomyia flaticrustum* Gagné

Hickory puff tart gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

44a Gall with false chamber above larval chamber 45
44b Gall without false chamber 47
45a Gall nearly three times as long as wide, sheathed at base by leafy exfoliation; false chamber open at apex, Plate 71 (1-2) ..... *Caryomyia caminata* Gagné

Hickory chimney gall. Galls occur between veins on the lower side of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America, but rare.

45b Gall no more than twice as long as wide, without leafy extension surrounding base; false chamber closed 46

46a Gall texture rubbery; about as wide as long; with umbo at apex, Plate 70 (7-8) ..... *Caryomyia inflata* Gagné

Hickory rubbery gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America, but not east of the Appalachians except in central Georgia.

46b Gall woody; about twice as high as wide; without umbo at apex, Plate 71 (3-4) ..... *Caryomyia ovalis* Gagné

Hickory ovoid gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America, but rare.

47a Gall elongate-cylindrical, usually at least twice as long as wide 48

47b Gall spheroidal or conical, about as long as wide 51

48a Gall base with shallowly concave, circular, central depression, not set into leaf socket 49

48b Gall base conical or deeply recessed, set into surrounding leaf socket 50

49a Gall surface minutely striate; apex pointed, Plate 65 (1-5) ..... *Caryomyia striolata* Gagné

Hickory fluted cone gall. This species and *C. albipilosa* are the two *Caryomyia* galls that dehisce in spring instead of later in the season. Galls occur between veins on the underside of the leaflets. Hosts: *Carya* spp., both sections. Distr.: eastern North America.

49b Gall surface smooth; apex blunt, with umbo at center, Plate 65 (8-9) ..... *Caryomyia urnula* Gagné

Hickory urn gall. Galls occur between veins on the lower surface, rarely the upper surface of the leaflets. Newly dehisced galls bounce around due to the activity of the larva inside. Hosts: *Carya* spp., both sections. Distr.: eastern North America.

50a Gall evenly cylindrical; base conical, Plates 64 (1f), 68 (3-6) ..... *Caryomyia tubicola* (Osten Sacken)

Hickory bullet gall. Galls usually occur on the lower surface of the leaflets between veins, occasionally, especially on *C. cordiformis*, closely adjacent to veins. Hosts: *Carya* spp., both sections. Distr.: eastern North America.

50b Gall tapered from base to pointed apex; base deeply recessed, Plate 68 (1-2) ..... *Caryomyia subulata* Gagné

Hickory awl-shaped gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America, but not east of the Appalachians except in New England.

51a Gall wall uniformly thin, of same shape as larval chamber 52
51b Gall wall thick, extraneous to shape of larval chamber 55
52a Gall spherical, with umbo or nipple at apex 53
52b Gall spheroidal, narrowed beyond midlength 54
53a Gall surface minutely striate, green; with prominent nipple at apex, Plate 67 (3-4) .... *Caryomyia leviglobus* Gagné

Hickory smooth ball gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

53b Gall surface smooth, glaucous; with small umbo at apex, Plate 67 (9-10) .... *Caryomyia glauciglobus* Gagné

Hickory blue-powder gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

54a Gall abruptly narrowed beyond midlength to blunt apex; on lamina, Plates 66 (12), 67 (1-2) … ..... *Caryomyia shmoo* Gagné

Hickory shmoo gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

54b Gall gradually narrowed beyond midlength to pointed apex; on veins, Plates 64 (1h), 67 (11-12) ..... *Caryomyia caryaecola* (Osten Sacken)

Hickory onion gall. Galls occur along the veins on the underside of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

55a Gall short-cylindrical, apex flat to concave; base sheathed by leaf exfoliation 56
55b Gall conical to spheroidal; base not sheathed by leaf exfoliation 57
56a Gall surface minutely striate, rugose apically, Plate 69 (1-2) .... *Caryomyia striolacrustum* Gagné

Hickory striate tart gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

56b Gall surface smooth, Plate 69 (3-4) ..... *Caryomyia levicrustum* Gagné

Hickory plain tart gall. Galls occur between or on veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

57a Gall conical 58

57b Gall spheroidal 61
58a Gall surface covered with conspicuous bumps, Plate 72 (10-11) … *Caryomyia glebosa* Gagné

Hickory knobby cone gall. Galls occur along veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

58b Gall surface smooth except for longitudinal furrows 59
59a Gall base curved upwards, apex set in resulting concavity, Plate 73 (9-10) ..... *Caryomyia arcuata* Gagné

Hickory sombrero gall. Galls occur between veins on the lower side of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

59b Gall base parallel to leaf 60
60a Gall base expanded horizontally, usually stellate; cone elongate-attenuate, Plate 73 (11) ..... *Caryomyia stellata* Gagné

Hickory starry-base gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

60b Gall broadly conical, Plates 64 (1i), 73 (2-4) ..... *Caryomyia sanguinolenta* (Osten Sacken)

Hickory smooth gumdrop gall. Galls occur between veins on the lower surface of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

61a Gall spheroidal, attached to vein; with many larval chambers, Plates 64 (1a), 75 (6-8) ..... *Caryomyia cynipsea* (Osten Sacken)

Hickory smooth woody gall. Galls occur along veins on the lower surface of the leaflets. This is the only polythalamous gall made by a *Caryomyia*. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America.

61b Gall depressed-spheroidal, on lamina; with single larval chamber, Plate 73 (12) ..... *Caryomyia biretta* Gagné

Hickory beret gall. Galls occur between veins on the lower side of the leaflets. Hosts: *Carya* (*Eucarya*) spp. Distr.: eastern North America except in mid-Atlantic states.

Juglans (walnut)

Folded or swollen young leaflets ..... *Contarinia* sp. and *Dasineura* sp.

Contarinia sp. Larvae were taken from folded, swollen leaves of butternut in New York and from folded but not swollen leaves of black walnut in West Virginia. Hosts: *J. cinerea, J. nigra*. Distr.: New York, West Virginia.

Dasineura sp. Larvae were taken from swollen leaves. Host: *J. nigra*. Distr.: Virginia.

Juncaceae

Juncus (rush)

Swollen culms ..... *Procystiphora coloradensis* Felt and *Procystiphora junci* Felt

P. coloradensis. Adults were reared in July. Host: Originally given as "possibly *Carex*"; *Carex* might well be the host, but other known *Procystiphora* spp. come from *Juncus* in both North America and Europe. Distr.: Colorado.

P. junci. Adults were reared in October. Host: *J. dudleyi*. Distr.: Illinois.

Lamiaceae

Blephilia (pagoda plant)

Stem swelling ..... *Neolasioptera* sp.

Affected stems are barely swollen and the tissue inside is hollow. Host: *B. hirsuta*. Distr.: Iowa. See on BugGuide.

Collinsonia (horsebalm)

1a Swollen, unopened flower ..... *Schizomyia* sp.

The greenish-yellow larva of this unnamed species is very active when disturbed. In late September or October in Maryland it leaves the gall and drops to the ground to overwinter. Host: *C. canadensis*. Distr.: Maryland.

1b Leaf galls 2
2a Onion-shaped gall, Plate 77 (7a) ..... *Dasineura collinsoniae* (Beutenmüller)

Galls are green, sparsely haired, thin walled, about 5-7 mm high and 3-5 mm in basal diameter and usually on the underside of the leaf. The single white larva in each gall breaks out to drop to the soil in early fall. Larval characters place this species in the Lasiopteridi. The species is tentatively placed in *Dasineura* until adults are reared. Host: *C. canadensis*. Distr.: New York and Maryland.

2b Swollen midrib or lateral vein, Plate 77 (7b) ..... *Lasioptera collinsonifoliae* (Beutenmüller)

Galls are green, tapered and 1-2 cm long. The one to several white larvae in the central tunnel

of each gall overwinter in the gall and pupate the following spring. Host: *C. canadensis*. Distr.: New York and Maryland.

Cunila (cunila)

Swollen bud gall, Plate 77 (8) …… cecidomyiid

Galls are 2-4 mm in diameter, green at first, becoming bluish-purple. Host: *C. origanoides*. Distr.: Indiana. Wells 1921b.

Galeopsis (hemp-nettle)

Irregular stem swelling …… *Neolasioptera galeopsidis* (Felt)

Galls are spongy, polythalamous and 1-2 cm long. The orange larvae live in elongate silk-lined chambers. Host: *G. tetrahit*. Distr.: Massachusetts. Gagné 2018b.

Glechoma (ground ivy)

1a Folded, swollen leaf base, Plate 77 (9) …… *Dasineura glechomae* (Kieffer)

One or more white larvae live in a pocket at the base of a leaf. This species is a European immigrant, as is its host. Host: *G. hederacea*. Distr.: Maryland and Europe.

1b In ovaries/seeds …… *Dasineura* sp., not *glechomae* (Kieffer)

Pinkish orange larvae, each replacing a flower, were found in mid-June in northern New York. Host: *G. hederacea*. Distr.: New York, presumably an immigrant.

Hedeoma (false pennyroyal)

Swollen flower bud …… cecidomyiid

The calyx is swollen and nutlets do not develop. Host: *H. pulegioides*. Distr.: Indiana. Wells 1921b.

Hyptis (bushmint)

Soft, hairy bud gall …… *Asphondylia* sp.

Galls have several chambers, each with a single larva. Host: *H. alata*. Distr.: Florida.

Lycopus (water horehound)

Swollen stem …… *Neolasioptera lycopi* (Felt) and *Neolasioptera mitchellae* (Felt)

N. lycopi. Swellings are monothalamous, subglobular, hard and about 1 cm long. The pale orange larva lives along the central axis and overwinters in the gall. Hosts: *L. uniflorus*. Distr.: New York and Maryland. Gagné 2018b.

N. mitchellae. Swellings are polythalamous and spongier and more elongate than those of *N. lycopi*. Larvae overwinter in the gall. Host: *L. virginicus*. Distr.: Maryland. Gagné 2018b.

Mentha (mint)

1a Swollen stem …… *Neolasioptera* sp.

This species is not identified further. Plakidas (2016) attributed the record from Pennsylvania to *Neolasioptera menthae* Felt, a species originally reared from "a mint," the genus unspecified. Because the larva and host of *N. menthae* are unknown, it is unidentifiable and considered a nomen dubium (Gagné 2018b). Host: *M. arvensis*. Distr.: Pennsylvania.

1b Crumpled or folded leaf or swollen bud …… 2
2a Crumpled or folded young leaf, Plate 77 (11) …… *Dasineura aromaticae* Felt

Larvae are gregarious within the leaf folds. Infested leaves are usually hairy. Larvae form cocoons and pupate among the distorted leaflets. Hosts: *M. arvensis*, *M. spicata*. Distr.: Massachusetts and New York.

2b Swollen bud …… 3
3a Loose, leaf bud gall …… *Dasineura piperitae* Felt and *Ametrodiplosis piperitae* (Felt)

D. piperitae. Leaves forming the gall are reportedly loosely appressed and about 5 mm long. Larvae are pale green. Adults were reared in early August. Hosts: *M. arvensis*, *M. aquatica*. Distr.: New York, New England. Eiseman 2025a.

A. piperitae (Felt) was reared from a similar gall but on a different host. Host: *M. aquatica*. Distr.: New York. Gagné 2018b.

3b Unopened flower buds …… *Ametrodiplosis menthae* Plakidas

The damage was noticed in July through early September. Fully grown larvae drop to the soil. Larvae of a *Contarinia* were also found in the galls. Host: *M. arvensis*. Distr.: Pennsylvania, ?Oregon. Plakidas 2016, See on iNaturalist.

Monarda (beebalm)

1a Tubular leaf gall …… *Ametrodiplosis fistulosae* Plakidas

Galls are tubular, 2 mm wide, 4 mm long and appear on the upper leaf surface from June through August. Full-grown larvae drop to the soil. Host: *M. fistulosa*. Distr.: Pennsylvania. Plakidas 2016.

1b Swellings of stem or rhizome …… 2
2a Elongate, tapered stem swelling, Plate 77 (10) …… *Neolasioptera monardi* (Brodie)

Swellings are 1-3 cm long. Host: *M. fistulosa*; *Monarda sp*. Distr.: Ontario, Iowa. Gagné 2018b.

2b Spheroid protuberance on "root" (presumably the rhizome) …… ?*Ametrodiplosis* sp.

Felt (1940, 1965) listed the gall midge as "*Cecidomyia* sp." His unpublished notebook noted the larva as lemon-yellow, which is consistent with the larva and gall of the *Ametrodiplosis* on *Pycnanthemum*, q.v. Host: *M. fistulosa*. Distr.: Ontario.

Nepeta (catnip)

Stem swelling …… cecidomyiid

Swellings were reportedly about 1 cm long. This plant is an alien in North America so the gall maker may also be an alien. Host: *N. cataria*. Distr.: unspecified.

Prunella (selfheal)

1a Leaf pocket or leaf roll …… cecidomyiid

The symptoms were reported by Maze (1949) with no further details. Host: *P. vulgaris*. Distr.: Pennsylvania.

1b From flowers, the niche or damage not apparent …… *Contarinia* sp.

Host: *P. vulgaris*. Distr.: Pennsylvania.

Pycnanthemum (mountainmint)

The gall midge fauna from flower heads is numerous and speciose. A *Contarinia*, a *Dasineura*, a *Neolasioptera*, a *Prodiplosis* and two species of *Lestodiplosis* were reared from flowers of *P. tenuifolium* in West Virginia, but their niches were not determined.

1a Leaf bud galls …… 2
1b Stem or rhizome galls …… 3
2a Early spring galls, consisting of two loose, modified pairs of leaves, Plate 79 (1-2) ……
…… *Dasineura laquerrarum* Gagné

Full-grown larvae are yellow. Two generations occur in early spring, the first in April, when the plants are only about 15 cm tall, and the second in May. By mid-June all the larvae have dropped to the soil where they remain until the following year. Galls are persistent but turn black after the larvae have left. Hosts: *Pycnanthemum* spp. Distr.: Connecticut, West

Virginia, Maryland and Virginia.

2b Late spring and summer galls, consisting of two fused, cuplike leaves, Plate 78 (3-4) …… …… *Ametrodiplosis geminata* Gagné

Larvae are yellow with a bright green gut. Galls of this species are evident by late June and are persistent. Several generations occur through the summer. Larvae live in the soil through winter. Hosts: *Pycnanthemum* spp. Distr.: West Virginia, Maryland, Virginia and North Carolina.

3a Rhizome swellings, Plate 78 (2-4) …… …… *Ametrodiplosis recondita* Gagné and *Hypogeadiplosis intrusa* Gagné

A. recondita. This species is responsible for the galls, which are 4-8 mm in diameter, irregularly spheroid, off-white to brown outgrowths of rhizome buds. Each gall harbors one to several larvae; if more than one, each is in its own chamber. Larvae are yellow with a bright green gut and can be found in galls throughout the year. Pupation occurs in the galls and adults can be reared all summer long. Hosts: *Pycnanthemum* spp. Distr.: West Virginia, Maryland and Virginia.

H. intrusa. Larvae of this inquilinous species are white and only occasionally found in galls of *A. recondita*. Pupation occurs in the galls. Pupae are notable for their prominent antennal bases. Host: *P. tenuifolium*. Distr.: West Virginia.

3b Fusiform or spheroid stem galls …… 5
4a Fusiform, sometimes barely swollen, stem galls, Plate 78 (5-6) … *Neolasioptera truncata* Gagné

This species is responsible for a 5-10 mm long, woody, fusiform swelling on stems and branchlets. The swelling is at first green, becoming dark purplish brown. A single yellow larva lives in the central longitudinal axis where it appears to hollow out the pith. Prior to pupation in place, the larva prepares an exit channel through the woody tissue almost completely through the bark. Pupation occurs in the gall. The fully developed adult inside the pupa pushes through the last bit of tissue still present at the end of the exit channel. In West Virginia, galls appear in early May when the host is only about 15 cm high and new galls continue to appear farther up the stem until the plant is fully grown. This species has at least two generations per year. Hosts: *Pycnanthemum* spp. Distr.: Iowa, West Virginia, Maryland, Virginia and Connecticut. See on BugGuide.

4b Spheroid stem galls, Plate 78 (5-6) …… *Lasioptera lorrainae* Gagné

Galls are spheroid, 5-8 mm in diameter, depending on the number of larvae inside, and occur in early summer on lateral twiglets and later near branch tips subtending the flower heads. One to several yellow larvae may occur in a gall, each in a separate elongate-ovoid chamber whose individual walls become increasingly hard as the larvae mature. Larvae do not form a cocoon. Galls are light green and fleshy early in the season but become brown and harden as the season progresses. There may be only one generation per year. Hosts: *Pycnanthemum*

spp. Distr.: Iowa, West Virginia, Maryland and Connecticut.

Salazaria (bladder sage)

Stem swelling …… *Neolasioptera* sp.

Swellings are symmetrical and tapered, the same color as the plant, ca 14 mm long by 3 mm in diameter. A single orange larva inhabits each gall and appears to overwinter in the gall. Host: *S. mexicana*. Distr.: Mojave Desert, California. Russo 2021.

Salvia (sage)

1a Hard, tubular or spheroidal outgrowths of leaves and stems, Plate 77 (12-15) …… …… *Rhopalomyia* spp.

Sages in western North America and Mexico evidently support many kinds of galls formed by *Rhopalomyia* spp. of which several kinds are represented in the USNM. Galls are monothalamous although they may form close aggregates. Larvae pupate in the galls and adults emerge through a hole that develops at the apex. Galls are first seen in late winter and adults can be reared from them in spring. Another generation must occur elsewhere on the plant because adults have short lives. Two *Rhopalomyia* species have been described from *Salvia*:

R. audibertiae Felt. Galls are cylindrical, narrowing from the base and the same color as the leaf (Plate 77 (12, 15)). Adults were reared from the galls in summer. Host: *S. apiana*, *S. mellifera*. Distr.: Baja California. Russo 2021.

R. salviae Felt. Galls are cylindrical and reddish. Host: *S. apiana*, *S. mellifera*. Distr.: California. Russo 2021.

1b Soft, spherical leaf gall …… *Asphondylia* sp.

Host: S. *leucantha*. Distr.: Morelos. Gagné 1994.

Scutellaria (skullcap)

Oval stem swelling …… cecidomyiid

Galls are reportedly about 1 cm long (Felt 1940, 1965). Host: *Scutellaria* sp. Distr.: unspecified.

Stachys (hedge nettle)

Ovate stem swellings at base of nodes …… *Neolasioptera* sp.

Oregon galls are red, those from Iowa and Minnesota, green. Whether these otherwise similar

galls are made by the same gall midge is unknown. Larvae, single or several in a gall, live in separate tunnels in the white interior. Full-grown larvae are orange. Hosts: *S. chamissonis*, *S. cooleyae*, *S. palustris*, *S. tenuifolia*. Distr.: Oregon, Iowa, Minnesota. See on BugGuide.

Teucrium (germander)

1a Curled and deformed leaf ..... cecidomyiid

This damage was reported without further details (Maze 1949). Host: *T. canadense*. Distr.: Pennsylvania.

1b Stem galls 2
2a Fusiform to spheroidal, green, fuzzy stem swelling found at nodes ..... *Neolasioptera* sp.

Galls often grow in chains along stem. Full-grown larvae are found in tight, woody chambers, but the rest of the gall is pulpy. Host: *Teucrium canadense*. Distr.: Iowa, Ohio. Sears 1914.

2b Fusiform, basal stem galls, at or just above soil level, see Image 66 ..... *Neolasioptera* sp.

This gall sometimes has roots growing adjacent to the swelling. Host: *Teucrium canadense*. Distr.: Oklahoma.

Lauraceae

Lindera (spicebush)

1a Rolled leaf or leaf margin ..... *Contarinia* sp. and *Dasineura* sp.

Larvae of both genera can be found together in the rolled leaves, where one or the other may be inquilinous. Galls are noticeable as soon as the leaves are fully expanded. Larvae drop to the ground when full-grown later in spring. Infested leaves turn black and drop off shortly afterward. Host: *L. benzoin*. Distr.: New York to Alabama.

1b Irregular stem swelling, Plate 80 (4) ..... *Neolasioptera linderae* (Beutenmüller)

Galls contain several orange larvae in separate long chambers. Adults emerge in spring from the previous year's galls. Host: *L. benzoin*. Distr.: New York, Maryland and Virginia.

Litsea (litsea)

In fruit ..... *Neolasioptera* sp.

Only larvae are known. They were intercepted in cargo at Laredo, Texas. Host: *L.* "*nuevoleonensis*." Distr.: Mexico (unspecified).

Persea (avocado)

In young fruit ..... *Asphondylia websteri* Felt and *Bruggmanniella perseae* Gagné

A, websteri Felt. Larvae of this generalist species were taken and adults reared from damage to avocado similar to that caused by *B*. *perseae*. For a full list of known hosts of *A*. *websteri*, see that species in the *Parkinsonia* listing under Fabaceae. Host: *P*. *americana*. Distr.: Guatemala. Hoddle 2008.

B. *perseae* Gagné. Eggs are laid singly in newly formed ovaries. The resulting aborted fruit grow no more than 2 cm long, the larval chamber replacing the ovary. Pupation occurs in place. After adults depart, the aborted fruit drop to the soil. Host: *P*. *americana*. Distr.: Mexico, Costa Rica and Colombia. Gagné et al. 2004.

Sassafras (sassafras)

1a Curled leaf or leaf margin ..... *Dasineura sassafras* Felt

This species is known only from a female reared in August from larvae collected earlier the same year. Host: *S*. *albidum*. Distr.: Ontario.

1b Slightly convex leaf spots, Plate 80 (3) ..... *Contarinia* sp.

Spots are about 3 mm in diameter and the same color as the leaf when the larva is present. Full-grown larvae escape from inside the leaf and drop to the soil in late spring, the spots turn black. Host: *S*. *albidum*. Distr.: Pennsylvania and Maryland.

Liliaceae

Liliaceae as formerly defined and as used in the previous edition (Gagné 1989) has since been divided among several families. The genera no longer here can be found under the following headings: Amaryllidaceae for *Allium*; Asparagaceae for *Brodiaea*, *Camassia*, *Maianthemum*, *Polygonatum*, *Triteleia* and *Yucca*; Asphodelaceae for *Hemerocallis*; Colchicaceae for *Uvularia*; and Smilacaceae for *Smilax*.

Lilium (lily)

Swollen to normal-appearing stem ..... *Neolasioptera* sp.

Orange larvae were found in great numbers in the pith of the upper parts of the stalks and flower peduncles. The infestation caused bud-drop and leaf necrosis of the flowering spike and distorted, ragged flowers below, resulting in heavy losses in some plantings. Adults were reared in August, indicating that this species has more than one generation per year. Felt (1940, 1965) identified this species as *Neolasioptera hibisci*, which originally came from stem galls on *Hibiscus* (Malvaceae) in Florida and has since been found among fungal

hyphae growing on the cork end of cantaloupe, *Cucumis melo*. The specimens reared from *Lilium* are poorly slide-mounted so cannot be properly compared to those from *Hibiscus*, but identification of this species could be resolved when more adults from *Lilium* are reared. Hosts: *L. auratum*, *L. canadense*, *L. regale*, *L. speciosum* and *L. tigrinum*. Distr.: New York and Wisconsin. Imle and Hartzell 1939.

Medeola (Indian cucumber)

Swellings along stem and on flower head …… *Asphondylia* sp.

Swellings are fleshy but those in flower heads less noticeably so. Adults emerged in late August. Host: *M. virginiana*. Distr.: Virginia.

Linaceae

Linum (flax)

Swelling on branch of flower head, Plate 80 (8) …… *Neolasioptera* sp.

Galls were collected in November with apparently diapausing larvae. Host: *L. sulcatum*. Distr.: New York.

Loasaceae

Mentzelia (blazing star)

Enlarged flower bud …… *Asphondylia mentzeliae* Cockerell

Adults were reared in August. Host: *M. multiflora*. Distr.: New Mexico.

Lythraceae

Cuphea (waxweed)

Greatly swollen, aborted flower …… *Asphondylia* sp.

Hosts: *Cuphea* spp. Distr.: southern Mexico to Panama. Graham 1995.

Decodon (decodon)

Thickened, overlapping bud leaves …… cecidomyiid

Infestations involve the 2-3 uppermost bud leaves on both terminal and lateral buds. Swollen

buds are 3-5 mm long. Each contains a single larva. Host: *D. verticillatus*. Distr.: Connecticut. Wells 1914.

Magnoliaceae

Liriodendron (tuliptree)

1a Green, yellow or black leaf spot, Plate 80 (9a) …… *Resseliella liriodendri* (Osten Sacken)

Galls are circular, 5-6 mm in diameter, monothalamous and occasionally discolored beyond the gall circumference. Full-grown larvae make a slit along the edge of the spot and drop to the soil, following which the spots turn black. Several generations occur per year. Galls appear in late May in Maryland and can be seen on new leaves all summer long. Host: *L. tulipifera*. Distr.: eastern North America.

1b Swollen midrib or vein, Plate 80 (9b) …… *Resseliella tulipiferae* (Osten Sacken)

Swellings are more noticeable on the underside of the leaf and each contains one to several larvae. These can be seen in Maryland by early June and appear through the summer on new leaves. Probably several generations occur per year. Full-grown larvae drop to the ground to pupate. Host: *L. tulipifera*. Distr.: eastern North America.

Magnolia (magnolia)

Leaf spot, 4.5 mm diameter …… *Contarinia* sp.

Only larvae are known of this undescribed species. Leaf spots have a similar appearance to those formed on *Liriodendron tulipifera* by *Resseliella liriodendri* and show a similar slit along the periphery when the larvae leave. In Maryland, larvae are found in mid-July and later. Host: *M. virginiana*. Distr. Maryland to Florida.

Malpighiaceae

Byrsonima (byrsonima)

Leaf gall …… *Dasineura* sp.

The gall was not described further. Host: *B. lucida*. Distr.: Florida.

Malvaceae

Abutilon (Indian mallow)

Elongate, aborted flower …… *Asphondylia abutilon* Felt

Infested flowers are about 7 mm long. They remain closed and internal parts do not develop. Galls enclose a single larva or pupa. Adults emerge from galls in late summer and fall. Host: *A. incanum*. Distr.: Texas.

Gossypium (cotton)

1a Leaf midrib fold or leaf roll …… cecidomyiid

Larvae are gregarious and deform the young expanding leaves. Host: *G. thurberi*. Distr.: Arizona. Pierce and Morrill 1914.

1b Swollen flower bud …… *Contarinia gossypii* Felt and *Prodiplosis longifila* Gagné

C. gossypii. This species, known otherwise from the West Indies, was reported as very common in Florida (Rainwater 1934), but specimens from that record are lost. Flowers reportedly remain closed and eventually rot. Host: *Gossypium* sp. Distr.: Florida; West Indies.

P. longifila. This species was reared from wild cotton buds in Florida. It may possibly be the species reported in Rainwater (1934) as *C. gossypii*. It has larvae similar to those of *Contarinia*, is multivoltine and has extensive geographical and host ranges (Gagné 1994). Hosts: *Gossypium* spp.; also, *Citrus* (q.v.); in South America, various Solanaceae (including potato), Chenopodiaceae, Fabaceae and Euphorbiaceae. Distr.: Virginia to Florida, also Colombia and Peru. Peña et al. 1989.

Hibiscus (rose mallow)

1a Swollen stem …… *Neolasioptera hibisci* (Felt)

Galls are irregular, ridged and 2-3 cm long. Larvae develop in tunnels, mainly in the pith, overwinter in the stalks and pupate there in spring. Originally from stem galls on *Hibiscus* (Malvaceae) in Florida, it was reared on one occasion from larvae taken among fungal hyphae growing on the cork end of cantaloupe in Honduras (Gagné 1994). Hosts: *H. moscheutos* and, in Honduras, *Cucumis melo* (Cucurbitaceae), q.v.; also, possibly *Lilium* q.v. Distr.: New York, North Carolina and Louisiana; Honduras. Gagné 1994.

1b Aborted flower bud …… *Contarinia maculipennis* Felt and *Prodiplosis longifila* Gagné

C. maculipennis. Larvae are found in unopened flowers. Full-grown larvae drop to the soil. This species is from SE Asia and is often intercepted at US ports of entry on commercial flower crops, including dendrobium orchids and jasmine from Asia. Hosts: *Hibiscus* sp. and various other plants (q.v. under orchids). Distr.: SE Asia, Hawaii, and fortuitous in North America but not established. Gagné 1995b, Uechi et al. 2003, 2012, Tokuda & Uechi 2021.

P. longifila. Larvae were found in flower buds. Hosts: *Hibiscus* sp. and see the note under *Gossypium*. Distr.: Florida and see also under *Gossypium*.

Kosteletzkya (kosteletzkya)

Tapered stem swelling ..... *Neolasioptera* sp.

This species has two and possibly more generations per year, the second generation occurring in galls higher up on the stem. Adults were reared in July in Maryland and Florida from galls on the lower stem, while new galls were already evident higher up. Hosts: *K. virginica*, *Kosteletzkya* sp. Distr.: Maryland, Florida to Texas.

Napaea (glade mallow)

Unopened, aborted flowers ..... *Clinodiplosis* sp.

Affected flowers turn brown. Larvae are gregarious and drop to the soil when full-grown. Host: *N. dioica*. Distr.: Iowa. See on BugGuide.

Sphaeralcea (globe mallow)

1a Larva in unopened, aborted flower, see Image 67 ..... *Asphondylia* sp.

Fresh pupal exuviae were found sticking out of the side of a flower in early November. Host.: *S. angustifolia*. Distr. Texas. Eiseman 2025a.

1b Larva in bud ..... *Contarinia* sp.

Adults were reared from buds in spring, but the damage was not specified further. Hosts: *S. coccinea*, *S. emoryi*. Distr.: Texas and Arizona.

Tilia (basswood)

1b Irregularly swollen young bud or twig, Plate 95 (2) ..... *Contarinia citrina* (Osten Sacken)

Galls are polythalamous, succulent when young, becoming woody, and up to 2.5 cm in diameter. Full-grown larvae drop to the soil to overwinter. Adults have not been reared. Generally similar galls are made in Europe by *Contarinia tiliarum* Kieffer on *Tilia* spp. Host: *T. americana*. Distr.: Illinois to Massachusetts, south to Florida.

1b Leaf galls 2
2a Wartlike, circular gall, Plate 95 (3) ..... *Contarinia verrucicola* (Osten Sacken)

The gall, about 3 mm diameter, projects from both upper and lower sides of the leaf, between and on ribs and veins. It begins as a green bump in spring but soon turns brown and hard. The one or two larvae in each gall drop to the soil from the underside of the leaf. Active galls

were found as early as May in Maryland. The number of generations, if more than one, is unknown. Host: *T. americana*. Distr.: Widespread eastern North America.

2b Flat, circular, laminar spot or vein swelling …… 3
3a Flat, circular laminar spot, Ssee Image 68 …… *Contarinia* sp.

The gall, about 3 mm diam., is barely a blister and the single white larva inside may be visible externally through the thin covering. As with *C. verrucicola*, active galls were found as early as May in Maryland. The number of generations, if more than one, is unknown. The single larva in each spot escapes from the gall and drops to the soil to pupate. Host: *T. americana*. Distr.: Widespread eastern North America.

3b Slight vein swelling, see Image 69 …… *Contarinia* sp.

This is a simple, swollen vein with one of more larvae inside. Host: *T. americana*. Distr.: Mid-Atlantic Region.

Montiaceae

Claytonia (spring beauty)

Elliptical, translucent leaf spot, see Image 70 …… *Dasineura* sp.

When full-grown, the larva inside each spot becomes noticeable as the surrounding leaf surface turns yellow. No leaf swelling is apparent. Yellow larvae exit in mid-April in Maryland from a slit in the leaf surface and drop to the soil where they remain until the following spring. Host: *C. virginica*. Distr.: Maryland, North Carolina.

Moraceae

Artocarpus (jackfruit)

Larvae on fruit, feeding on fungus …… *Clinodiplosis ultracrepidata* Gagné

Adults may be found ovipositing on male inflorescences where the larvae feed. Host: *Artocarpus heterophyllus*. Distr.: Florida, evidently introduced with its host from Asian tropics, known there from Malaysia. Gardner et al. 2018

Ficus (fig)

1a Enlarged seed capsules inside fruit …… *Ficiomyia perarticulata* Felt

Affected seed capsules are about five times larger than normal. Each contains a single larva. Adults were reared from fruit in February. Host: *F. citrifolia*. Distr.: Florida; West Indies.

Roskam and Nadel 1990.

1b Leaf blisters ..... *Horidiplosis ficifolii* Harris

This is an Asian gall midge that has been found with imported bonsai and nursery plantings. The larvae, orange and active when mature, drop out of the galls when full-grown. Adults emerge from the substrate 2-3 weeks later. Host: *F. microcarpa*, Chinese banyan tree. Distr.: originated in East Asia, found in Europe and, more recently, California and Florida. Harris & Goffau 2003, Steck & Kreuger 2008, Dara 2015.

Morus (mulberry)

Swollen, aborted buds ..... *Asphondylia* sp.

Galls are modified terminal and lateral leaf buds. They are light green, firm to the touch and 5-7 mm in diameter. A single larva lives in the center of each. Emergence occurred in early July. Host: *Morus rubra*. Distr.: Ontario.

Myricaceae

Comptonia (sweet fern)

Swollen midvein, causing severe leaf distortion, Plate 80 (5) ..... *Janetiella asplenifolia* (Felt)

Leaf midveins are fleshy and reddish; extreme folding of the leaf may occur. Larvae are gregarious. Host: *C. peregrina*. Distr.: Massachusetts, New York.

Myrica (bayberry)

1a Slightly deformed, open buds with rolled leaves, Plate 80 (6) .... *Prodiplosis myricae* (Beutenmüller)

Larvae are gregarious and drop to the ground when full-grown. Adults were reared in early August, so the species may have at least two generations per year. This gall midge is evidently a generalist; it has also been reared in association with leaf mines of *Liriomyza* sp. (Diptera: Agromyzidae) on *Euphorbia curtisii* (Euphorbiaceae) in North Carolina (C. Eiseman, in litt.). Host: *M. cerifera*. Distr.: New Jersey, North Carolina.

1b Large apical bud swelling ..... cecidomyiid

Galls may reach 1 cm diameter and contain many larvae in individual chambers. Pupation takes place in the gall. Host: *M. californica*. Distr.: California.

Myrtaceae

Eugenia (stopper)

1a Deformed fruit …… *Dasineura eugeniae* Felt

Adults were reared in March and August from deformed fruit, 4-9 mm in diameter, bearing separate, oval larval chambers. Host: *E. axilaris*, *E. foetida*. Distr.: Florida.

1b In complex leaf gall …… 2
2a Fuzzy, boot-shaped gall, Plate 80 (10a) …… *Stephomyia eugeniae* (Felt)

Galls are monothalamous and covered with white hairs. Similarly shaped but smooth, hairless galls are in the USNM collection; it is unknown if they belong to the same species of *Stephomyia*. Pupation occurs in the gall and pupae break out of the "toe" of the "boot." The galls are sometimes in aggregations that cover the entire surface of a leaf. Adults were reared from galls in March. Hosts: *E. supraaxillaris*, *E. foetida*. Distr.: Florida. Gagné 1994.

2b Smooth, conical, gall, Plate 80 (10b) …… *Stephomyia* sp.

Hosts: *E. supraxillaris*, *E. foetida*. Distr.: Florida.

Melaleuca (melaleuca; paperbark)

Swollen green stems, axillary buds and leaves, see Image 71 …… *Lophodiplosis trifida* Gagné

Galls are succulent, variably shaped swellings on new growth. Larvae live in individual chambers, as many as 100 in some of the larger stem galls, and pupate in place. More than 10 generations may occur per year. This species is effective in killing the growing tips of the alien paperbark, thereby reducing flower production. After testing for host specificity, the gall midge was introduced into the wild in southern Florida in early 2008 to help control its noxious host. It is now successfully reproducing on paperbark from the Atlantic to the Gulf coast of Florida. Host: *Melaleuca quinquenervia*. Distr.: Florida; native to Australia. Gagné et al. 2009.

Myrcia (bayberry, wax-myrtle)

Circular, raised, flat galls on leaves …… cecidomyiid

Galls are about 5 mm in diameter and slightly darker green than the surrounding leaf. Adults emerged from galls in early March. Host: *M. chytraculia*. Distr.: Florida.

Nyctaginaceae

Boerhavia (spiderling)

Swollen flowers and seeds ..... *Asphondylia boerhaaviae* Möhn

Host: *Boerhavia* spp. Distr.: Florida, Mexico (unspecified), also Jamaica, El Salvador and Colombia. Wünsch 1979, Freeman and Geoghagen 1987, 1989.

Mirabilis (four o'clock)

Swollen stem ..... *Neolasioptera allioniae* (Felt)

Swellings are polythalamous, tapered, 1.5-2.0 cm long and usually just below a node. Larvae overwinter in the stem and pupate in spring. Hosts: *M. nyctaginea* and *M. linearis*. Distr.: Arizona, Colorado, Iowa and Texas. Fernandes et al. 1993.

Pisonia (catchbird tree)

1a Subconic stem gall ..... *Pisoniamyia mexicana* (Felt)

The gall was not described further. Host: *Pisonia aculeata*. Tamaulipas.

1b Hard, woody, convex leaf gall, Plate 80 (11) ..... *Bruggmannia* sp.

Larvae pupate in the galls. Although listed as the *B. pisonifolia* (Felt) of St. Vincent, West Indies, in Gagné 1989, the Florida specimens appear to belong to a separate species. Adults were reared in early August from galls collected in late July. Host: *P*isonia *subcodata*. Distr.: Florida.

Nyssaceae

Nyssa (tupelo, black gum, sour gum)

1a Swollen, staminate flowers, Plate 57 (5b) ..... *Contarinia* sp. and *Clinodiplosis* sp.

Contarinia sp. Swellings are fruitlike and usually occur on staminate flowers on which they bear the pedicellate stamens in a circle. One to several larvae occur in a central cavity. Full-grown larvae drop to the soil, where they remain until the following spring. Host: *N. sylvatica*. Distr.: New Jersey, Maryland, Virginia.

Clinodiplosis sp. This species is an inquiline in the *Contarinia* gall. Adults emerged the same season as the galls developed. Since the *Contarinia* is univoltine, the *Clinodiplosis* must have another host or even be a generalist. Host: *N. sylvatica*. Distr.: Maryland, Virginia.

1b Twig or leaf galls 2
2a Swollen twigs ..... cecidomyiid

Swellings are reportedly about 6 cm long. Larvae associated with this damage were not preserved. Host: *N. sylvatica*. Distr.: Virginia.

2b Marginal leaf fold or leaf blister …… 3
3a Marginal leaf fold, Plate 57 (5a) …… *Cartodiplosis nyssaecola* (Beutenmüller)

This gall is formed by *Phylloxera nyssae* Pergande (Hemiptera: Phylloxeridae). The gall midge, originally believed to be the cause of the leaf fold, is an obligatory predator of the phylloxeran. Host: *N. sylvatica*. Distr.: New York and Maryland.

3b Leaf blister …… cecidomyiid

These are circular blisters or spots. When the blisters were found in mid-June, larvae had already dropped to the soil. Host: *N. biflora*. Distr.: North Carolina.

Oleaceae

Forestiera (swamp privet)

1a Complex, cylindrical, hairy leaf gall …… cecidomyiid

Galls are monothalamous, 2-3 mm high, 1 mm in diameter and appear in clusters. Adults emerged from the galls in March. Host: *F. segregata*. Distr.: Florida.

1b Apical, spherical twig gall, often with a few attendant leaves, see Image 72 …… *Contarinia* sp.

Galls are nearly 1 cm in diameter and woody after overwintering. A large, central chamber bore several cocoons from which adults emerged in early April. Host: *Forestiera pubescens*. Distr.: New Mexico.

Fraxinus (ash)

See Wagner & Todd (2015) for the impact on gall midges and other ash-restricted insects by the alien emerald ash borer, *Agrilus planipennis* (Coleoptera: Buprestidae).

1a Slight swelling of samaras or seeds …… *Contarinia* spp., *Dasineura* sp.

Larvae of at least two species of *Contarinia* have been found in samaras or seeds. One is gregarious in the slightly swollen exocarp of the samaras. Its damage is similar to that of the European *Contarinia marchali* Kieffer on a European ash. The other *Contarinia* sp. and the *Dasineura* sp. may have another niche in the seeds. Adults of one of the two *Contarinia* here were reared in spring from seeds collected in mid-July of the previous year. Host: *F. pennsylvanica*. Distr.: Ontario, Quebec.

1b Leaflet fold, roll or swelling …… 2

2a Folded leaflets with only a slight swelling along midrib, Plate 81 (2) ..... *Dasineura apicata* Felt and *Dasineura fraxinifolia* (Felt)

Adults of these two species of *Dasineura* are distinct, but larvae have not yet been properly associated with their respective adult stages. Gregarious larvae develop in spring on very young leaflets and drop to the ground when full-grown. The record here from Oregon is not necessarily one of those two species. Another cecidomyiid, *Rhizomyia fraxinifolia* Felt, was reared from similar damage but was doubtless secondary, presumably feeding on fungi. Hosts: *Fraxinus* spp. Distr.: New York to West Virginia and Oregon.

2b Succulent swellings of midribs or petioles 3

3a Succulent longitudinal swelling of midrib or petiole, especially prominent on underside; galls eventually open on upper surface of the leaflet, Plate 81 (1a), see Image 73 ..... *Dasineura tumidosae* Felt, *Contarinia thalactri* (Felt) and *Contarinia canadensis* Felt

D. tumidosae. This species is regularly and usually exclusively found in the galls. Larvae are gregarious, white and drop to the ground when full-grown, around the first week of June in Maryland. Leaflet swellings are barely noticeable from the top of the leaflet but are large, pendent and often reddish below. Larvae overwinter in the soil. Hosts: *Fraxinus* spp. Distr.: New England to Michigan, south to Virginia, and California.

C. thalactri. Larvae of this species are rarely found in these galls, so are presumably inquilinous. They are white and gregarious and have been reared in long series. Males have antennae shaped as in the female. Hosts: *Fraxinus* spp. Distr.: Ontario to Maryland.

C. canadensis. This species was reported from these galls in Felt (1940, 1965), but the original description states only that it was probably reared from ash (Felt 1908b). Host: ?*Fraxinus* spp. Distr.: Ontario.

3b Spheroid swelling on upper side of leaflets along veins, eventually opening on lower surface, Plate 81 (1b) ..... *Dasineura pellex* (Osten Sacken)

Galls may be green, purple, or black, each usually containing a single white larva, rarely more than one. Larvae drop to the soil in late spring, 2-3 weeks earlier in Maryland than in Maine. Adults have not been reared. A similar gall was found in Oregon, but no larvae from them were examined. *Neolasioptera fraxinifolia* Felt was originally recorded from this gall, but it may have been a contaminant in the rearing container; I have never found larvae of *Neolasioptera* in such galls. Host: *Fraxinus* spp. Distr.: northeastern North America.

Onagraceae

Chamaenerion (fireweed). See *Epilobium*.

Epilobium (fireweed).

In addition to the galls keyed below, a species of *Neolasioptera* was reared from *Epilobium brachycarpum* in Oregon. The source tissue of the plant could not be determined.

1a In rolled leaves of young buds …… *Contarinia zauschneriae* (Felt)

Larvae reportedly live in the center of the folded or curled leaves. Adults were reared in December. Hosts: *E. canum*, also *Oenothera* spp. Distr.: California.

1b In fruit, flowers or buds …… 2
2a In seed capsule …… *Dasineura* (s.l.) sp.

Larvae were found in association with a moth, *Mompha* sp. (Momphidae: Lepidoptera). Host: *E. paniculatum*. Distr.: Idaho.

2b In flowers or buds …… 3
3a In enlarged, unopened flowers, see Image 74 …… *Dasineura* epilobii (Löw)

Dasineura epilobii (Löw). Flowers become enlarged but remain unopened. They contain gregarious, yellow larvae that drop to the soil to pupate. This species has at least two generations per season. Hosts: *C. angustifolium, C. latifolium*. Distr.: widespread Canada and northern USA, northern Europe and western Siberia. Gagné et al. 2024.

3b In lateral bud galls, see Image 75 …… cecidomyiid

Fully grown larvae pupate in the gall. Host: *E. canum*. Distr.: California.

Ludwigia (water primrose)

Variably swollen and distorted pod …… *Asphondylia vincenti* Felt

Adults emerged from deformed pods in November and December. Hosts: *L. octovalvis* and *Ludwigia* spp. Distr.: Florida, also circum-Caribbean and El Salvador.

Oenothera (evening primrose)

1a Rolled leaves emerging from young bud …… *Contarinia zauschneriae* (Felt)

The species is based on specimens from California; a New Jersey record is only tentatively placed here. Larvae were found in midsummer at the bases of the leaves in the apical rosette. Hosts: *O. biennis*, *O.avita*, also *Epilobium canum*. Distr.: California and New Jersey. Dickerson and Weiss 1920.

1b Swelling at node …… *Neolasioptera* sp.

Swellings are up to 2 cm long, 1 cm wide and polythalamous. Galls were collected in early June and adults emerged in the same month, so more than one generation should occur per

year. Host. *O. macrocarpa*. Distr.: Oklahoma.

Orchidaceae

Cattleya*, *Dendrobium (tropical orchids)

1a In flower buds …… *Contarinia maculipennis* Felt

Gregarious larvae live in unopened flower buds, causing the flowers to abort. Full-grown larvae drop to the soil after which affected flowers quickly succumb to rot. This polyphagous species is from Southeast Asia and is often intercepted at US ports of entry. It was once found infesting *Dendrobium* orchids in a commercial greenhouse in Florida and, separately, also *Hibiscus* (q.v.). It has been recorded in Hawaii from *Hibiscus* and many commodities, including tomato and eggplant (Jensen 1946). Gagné 1995b; Uechi et al. 2012.

1b In aerial root nodules, Plate 84 (2), see Image 43 …… …… *Clinodiplosis cattleyae* (Molliard) and *Neolasioptera* sp.

C. cattleyae (Molliard). This species has been reared from orchid roots many times so is apparently specific to orchids. Hosts: *Cattleya* spp. and other Neotropical orchids. Distr.: Florida and tropical America.

Neolasioptera sp. This species is the one more commonly intercepted in root swellings at U.S. ports of entry in both commercial shipments and personal baggage. Hosts: *Cattleya* spp. and other Neotropical orchids. Distr.: tropical Americas.

Orobanchaceae

Aureolaria (false foxglove)

Larva in seed pods …… *Contarinia* sp.

This insect is the one recorded in Felt (1940, 1965) as *Cecidomyia* sp. from *Gerardia*. Larvae were collected in September. Host: *A. flava*. Distr.: New Jersey.

Pedicularis (lousewort)

In seed capsules …… *Clinodiplosis* sp.

An adult was reared either from seed capsules with no noticeable hypertrophy or from peduncles. Host: *P. canadensis*. Distr.: Massachusetts.

Oxalidaceae

Oxalis (wood-sorrel)

Larva in stem …… cecidomyiid

Larvae were found ranging along the interior of the stem of a native wood-sorrel. Host: *Oxalis* sp. Distr.: Iowa

Papaveraceae

Papaver (poppy)

Larva in base of stem …… *Karshomyia caulicola* (Coquillett)

White-mold gall midge. This insect is a mycophage associated with white mold, thus the common name. Originally found on poppy in New Hampshire in 1895, it has been found more recently on soybean (q.v.) in Quebec and midwestern USA. It is widespread in Europe; in the Netherlands it has been found on white mold in stems of beans and potatoes and in the stems and pods of winter rape. Hosts: *Papaver* sp. and various commodities including soybean. Distr.: North America and Europe. Koch et al. 2020.

Passifloraceae

Passiflora (passion flower)

In bud swellings …… *Schizomyia* sp.

Infested terminal or lateral buds are green, smooth and irregularly spheroid. The tissue inside the galls is light green with the consistency of an apple and has one to many irregularly ovoid larval chambers that enlarge as the larvae grow. Larvae are at first yellow, maturing to orange, after which they force their way to the exterior and drop to the soil. Adults emerged in early November from larvae that exited the swellings at the end of September. With new growth of the host available throughout the season, the gall midge may have several generations annually. Host: *P. tuberosa*. Distr.: Florida.

Piriqueta (stripeseed)

Larva in flower heads …… *Contarinia* sp.

Adults were reared in fall from flower heads. Host: *P. cistoides*. Distr.: Florida.

Phrymaceae

Diplacus (bush monkey flower)

1a Swollen stem …… *Neolasioptera mimuli* (Felt)

Swellings occur at midstem or at nodes; leaves or buds may extend from the galls. Adults emerged in November. Hosts: *D. aurantiacus*, *D. longiflorus*. Distr.: California.

1b Bud or flower gall …… 2
2a Woolly, rosette bud gall …… *Asphondylia diplaci* Felt

Host: *D. longiflorus*. Distr.: California.

2b Swollen, aborted flower buds …… *Asphondylia* sp.

Galls are 2.5-3.0 cm long and polythalamous with numerous individual larval chambers spread throughout the arrested floral parts. The *Asphondylia* from this gall is distinct from *A. diplaci*. Host: *D. aurantiacus*. Distr.: California. Russo 2025.

Mimulus (now *Diplacus*, in part, q.v.)

Phryma (lopseed)

Larva in stem internode …… *Neolasioptera* sp.

Affected stems are apparent only from a symptomatic blackening of the exterior. Host: *Phryma leptostachya*. Distr.: Iowa. See on BugGuide.

Phytolaccaceae

Phytolacca (pokeweed)

In unopened flower buds …… *Contarinia phytolaccae* Plakidas

Gregarious larvae crawl freely in the flower bud whose petals do not unfurl. Full-grown larvae drop to the soil. Host: *P. americana*. Distr.: Pennsylvania, Maryland.

Rivina (rivina)

Enlarged, unopened bud …… *Schizomyia rivinae* Felt

Infested buds are reportedly globular, downy and mostly green, with whitish or rose tips. Adults were reared in June from larvae that dropped out of the galls the previous October. Host: *R. humilis*. Distr.: Florida.

Pinaceae

Abies (fir)

1a Blister-like swelling of needle, Plate 81 (3) .... *Paradiplosis tumifex* Gagné and *Dasineura balsamicola* (Lintner)

P. tumifex, balsam gall midge. This species is responsible for initiating the gall. Females lay their eggs in spring as needles are elongating. The newly hatched larva crawls along the needle, settles and begins to feed. The needle then grows around the larva. Only one larva of this species is found in a gall. Larvae vacate the galls in late summer and drop to the duff where they pupate the following spring. Affected needles die and dehisce soon after the larvae leave. Hosts: *A. balsamea*, *A. fraseri*, *A. concolor*, *A. grandis*. I have not yet seen adults from the last two hosts so cannot state with certainty whether *P. tumifex* is the species involved. Distr.: Canadian Maritime Provinces to Wisconsin, south along the Appalachians to North Carolina, and California (the *A. concolor* and *A. grandis* records). Osgood and Gagné 1978, West and Shorthouse 1982, Bergdahl and Mazzola 1985, Akar and Osgood 1987, Osgood et al. 1992.

D. balsamicola. This species is an inquiline. Females lay eggs on needles in spring shortly after the gall maker *P. tumifex* has laid its eggs but before galls have formed. One or more larvae of *D. balsamicola* may be found in a *P. tumifex* gall where they grow faster than the gall maker, which eventually dies. Larvae of the inquiline and their needles drop to the duff a little later in the season than do needles infested only by *P. tumifex*. Pupation takes place the following spring. Host: *A. balsamea*. Distr.: Canadian Maritime Provinces to Wisconsin, and California. Osgood and Gagné 1978, Bergdahl and Mazzola 1985, Shorthouse and West 1986, Akar and Osgood 1987.

1b Larva in cone 2
2a Larva between cone scales 3
2b Larva inside seed or cone scale 4
3a Full-grown larva orange, with pebbled skin and spatula, Plate 11 (3) .... *Resseliella conicola* (Foote) and *Resseliella coryloides* (Foote)

Larvae appear singly or gregariously and may be present throughout the summer. They feed along the surface of the cone scales and cause discolored necrotic areas. The "scale midge" of Hedlin (1967) on *Abies grandis* in British Columbia is one of these two species, but they cannot be differentiated from larvae only. Hosts: *A. concolor*, *A. grandis*, *A. magnifica* and possibly other firs. Distr.: British Columbia to California. Hedlin 1967.

3b Full-grown larva white, smooth, Plate 3 (2), without spatula .... *Asynapta hopkinsi* Felt and *Asynapta strobilophila* Foote

Larvae are often gregarious and probably feed on fungi growing on already damaged cones. Several generations may occur per year. Hosts: *A. concolor*, *A. grandis*, *A. magnifica* and other conifers as well. Distr.: western Canada and western and southern United States.

4a Larva in scale swelling …… *Dasineura abiesemia* Foote

This is presumably the species reported in Hedlin (1967) as the "cone scale midge." Swellings on the scales are adjacent to the seeds. Usually one larva occurs per swelling; if two, the larvae are separated by a thin wall. Larvae overwinter in place where they pupate in spring. Cone scales sometimes fuse to the seeds, resulting in seed loss. An unidentified *Contarinia* sp. has also been reared from scales of a fir in British Columbia, but its niche is unknown. Hosts: *A. concolor*, *A. grandis*, *A. magnifica*, *A. shastensis*. Distr.: British Columbia to California. Hedlin 1967.

4b Larva in seed …… *Plemeliella* sp.

This is an undescribed species, only tentatively listed as a *Plemeliella*, referred to in Hedlin (1967) as the "seed midge." One larva occurs per seed and pupation occurs there the following spring. Nearly all infected seeds are aborted. Hosts: *A. grandis*, *A. lasiocarpa*. Distr.: British Columbia. Hedlin 1967.

Larix (larch)

Larva in seeds and between scales …… *Resseliella* sp.

Host: *L. laricina*. Distr.: Maine.

Picea (spruce)

In addition to the species in the key below, *Paradiplosis obesa* (Felt) also occurs on *Picea*. It was known until recently only from a single male caught in flight in New York. Adults have since been reared from cones in New Brunswick, but their niche inside the cone remains unknown.

1a Larva in cone …… 2
1b Larva in bud, swelling at base of needles, or resin on branches …… 7
2a Larva in seed …… 3
2b Larva in other part of cone …… 4
3a Seed deformed, discolored …… *Strobilotia carpophaga* (Tripp)

Eggs are laid in spring on developing cones. Larvae settle in the ovules that then swell to larger than normal size and grow irregularly. The pink larvae are full-grown by summer and overwinter in a cocoon in the seed. In Ontario pupation takes place in April and adults appear in early May. Host: *P. glauca*. Distr.: Ontario. Tripp 1955.

3b Seed apparently not deformed or enlarged …… *Plemeliella* sp.

Seeds must be cut open to find the orange larvae. This species is known only from larvae and only tentatively placed in *Plemeliella*. In biology and appearance the larvae resemble *Plemeliella abietina* Seitner of spruce seeds in Europe. Host: *P. glauca*. Distr.: Ontario. Tripp

1955, as ``Species A."

4a Larva in cone scale or rachis 5
4b Larva free between scales and seed wings 6
5a Larva in tunnel in rachis ..... *Kaltenbachiola rachiphaga* (Tripp)

The yellow-orange larvae live gregariously in pockets and sometimes fill the rachis. In midsummer larvae line the tunnel with their silken cocoons. Pupation occurs the following spring and adults emerge in mid-May. Host: *P. glauca*. Distr.: Quebec and Ontario. Tripp 1955.

5b Larva in swelling of cone scale, Plate 81 (4) ..... *Kaltenbachiola canadensis* (Felt)

Larvae occur singly in swellings that are occasionally numerous enough to give the cone a warty appearance. The orange larvae are full-grown by mid-July when they form cocoons in place. Pupation occurs the following spring and adults emerge around mid-May. Host: *P. glauca*. Distr.: Ontario. Tripp 1955.

6a Larva orange-red, with pebbled skin and clove-shaped spatula (Plate 11 (3)) ..... *Resseliella* sp.

These larvae may be secondary feeders in cones and can be fairly numerous. They drop to the ground when full-grown. Several generations may occur during the summer. Larvae of this genus occur also in cones of many other conifers. Host: *P. glauca*. Distr.: Ontario. Tripp 1955, as "Species B".

6b Larva white, smooth, without spatula, Plate 3 (2) ..... *Asynapta hopkinsi* Felt

These larvae are gregarious and may be feeding on fungi between the cone scales. Hosts: *P. englemannii* and many other conifers. Distr.: widespread in North America.

7a Larva in droplet or flow of resin ..... *Cecidomyia* sp.

Larvae of this undescribed species live submerged in resin except for their enlarged hind spiracles. Hosts: *P. glauca*, *P. pungens*. Distr.: Wyoming, Colorado and British Columbia.

7b Larva in swelling at tip of buds or on twig 8
8a Malformed, usually terminal bud ..... *Dasineura swainei* (Felt)

Eggs are laid singly or in clusters between basal scales or needles of elongating shoots in spring. Larvae crawl to the tips of the shoots and become embedded in individual chambers. The pink full-grown larvae overwinter in the galls and pupate the following spring. Bud growth is arrested and lateral shoots elongate to cause the development of multiple leaders and subsequent bushy growth. Hosts: *P. abies*, *P. glauca*, *P. mariana*, *P. pungens*, *P. rubens*. Distr.: Canadian Maritime Provinces to Alberta and New York. Clark 1952, Cerezke 1972.

8b Swellings along shoots and twigs, the twigs often bent 9

9a On native spruces, Plate 81 (5) ..... *Piceacecis tsugae* (Felt)

Eggs are laid at the base of fresh shoots. The larvae are always in individual chambers at the node or along the twigs. Full-grown larvae are reddish orange. Adults emerge from the galls in late May. Severe infestations cause twigs to bend and twist. Many needles drop off and twigs are sometimes killed. Hosts: *P. glauca*, *P. rubens*. Distr.: Canadian Maritime Provinces south to Connecticut and west to Manitoba. Smith 1952, Gagné & Graney 2014.

9b On Norway spruce, see Image 76 ..... *Piceacecis abietiperda* (Henschel)

This species is a recent introduction to North America. Its biology is similar to that of *P. tsugae* above except that emergence occurs in March and April. Distr.: New York and New England, south to Maryland. Host: *P. abies*. Gagné & Graney (2014).

Pinus (pine)

The gall attributed to *Dicrodiplosis gillettei* (Felt) is not keyed here. It is from Colorado and was initially described as an “apical, bud-like swelling, diameter, 1 cm; *Pinus scopulorum*” (Felt 1911). Further details given later were, "covered with brownish scales and, in one instance, with rudimentary needles arising from the sides" (Felt 1918c). An adult female *Clinodiplosis* sp. subsequently referred to this species (Felt 1918c) was possibly a secondary feeder in the gall.

1a Larva in cone 2
1b Larva in or on needles and branches 3
2a Larva immersed in resin between cone scales, the cone becoming deformed and sealed closed, Plate 82 (1-2) ..... *Cecidomyia bisetosa* Gagné

Eggs are laid on developing cones as early as January. Larvae enter the cones where their feeding causes resin to flow. Affected cone scales grow much larger than normal, may become deformed and sealed closed. This species has one generation per year, the larvae pupating in the cones in December and January. All other species of *Cecidomyia* live in resin on branches, twigs and needles of pines and a few other conifers. Host: *P. elliottii*. Distr.: Florida. Williams & Fatzinger 1977, Gagné 1978c.

2b Larva free between cone scales, often associated with secondary necrosis .... *Asynapta* spp., *Resseliella* sp. and other mycophagous and predaceous cecidomyiids

Asynapta spp. Included here are at least two species, *Asynapta hopkinsi* Felt and *Asynapta strobilophila* (Foote). Their white, gregarious larvae are often found in cones where they presumably feed on diseased tissue. Full-grown larvae drop to the ground to pupate. Hosts: *Pinus* spp. and possibly other conifers. Distr.: widespread across North America. Franklin and Coulson 1968.

Resseliella sp. As many as 100 orange larvae may live in a cone where they reportedly stimulate resin flow that causes the cone scales to stick together. Larvae pupate in the cone. They cause no deformation and are often found in association with *Asynapta* spp. Hosts:

Pinus spp.; possibly other conifers. Distr.: widespread across North America. Franklin and Coulson 1968.

Other secondary cecidomyiids. *Hyperdiplosis recurvata* (Felt), *Karshomyia triangularis* (Felt) and *Mycodiplosis thoracica* (Fitch) were reared from pine cones in southeastern United States. The first two are presumably mycophagous and the third definitely is. *Lestodiplosis* spp., predators of mites and other arthropods, have occasionally been reared from pine cones.

3a Larva immersed in droplet of resin at base of needle fascicle or in resin-filled pit or swelling on branches, Plate 82 (3, 6) 4

3b Larva in conical gall at apex of swollen, foreshortened branchlet or at base of needles, often causing foreshortening or bending of needles 6

4a Larva without dorsal tubercles on abdomen ..... *Cecidomyia* spp.

Larvae of the several species listed in this half-couplet are usually gregarious on red pines and pupate in the mass of resin in which they live, Plate 82 (3, 6). Identification of these species depends on characters of larvae, pupae and males. See Gagné (1978c) for a review and technical key to the species listed below.

C. fortunactus Gagné. Full-grown larvae of this species may be separated from the other species by the presence of a long, black, two-lobed spatula. It has been found at tips of pines where it possibly destroys the apical buds and forces lateral growth. Hosts: *P. elliottii* and *P. virginiana*. Distr.: Maryland to Florida.

C. reburrata Gagné. Hosts: *P. taeda* and *P. caribaea*. Distr.: Maryland to Florida, also Cuba.

C. resinicola (Osten Sacken). This species is the most widespread and probably the commonest North American species of this genus. It is known to injure the cambial layer and kill shoots. Hosts: known from almost all species of hard pine in North America. Distr.: coast to coast, Canada to Mexico and Florida, probably wherever pines naturally grow. Reeks 1960.

C. resinicoloides Williams, Monterey pine resin midge. Hosts: *P. banksiana*, *P. contorta*, *P. elliottii*, *P. ponderosa*, *P. radiata* and *P. virginiana*. Distr.: Ontario to Alberta south to Florida and California.

C. tortilis Gagné. Hosts: *P. clausa*, *P. virginiana*. Distr.: Maryland to Florida.

4b Larva with conspicuous tubercles on dorsum of abdomen 5

Larvae may be single to gregarious. They pupate in individual white cocoons, usually fastened with resin to a needle at some distance from the drop or mass of resin in which they fed. Identification of most of these depends on characters of larvae, pupae and males. See Gagné (1978c) for a review and technical key to the species in the next couplet.

5a Larva in running resin; on white pine, *Pinus strobus* ..... *Cecidomyia candidipes* Foote

Several larvae are usually found in the same pitch mass. Host: *P. strobus*. Distr.: Ontario and Quebec, south to Illinois and Maryland. Krauth 1999.

5b Larva in inconspicuous pits at base of needle fascicles, Plate 82 (4-5) .... *Cecidomyia brevispatula* Gagné and *Cecidomyia piniinopis* Osten Sacken

C. brevispatula. Hosts: *Pinus clausa*, *P. echinata*, *P. elliottii*, *P. radiata* and *P. virginiana*. Distr.: Maryland to Florida, and California.

C. piniinopis. This species and *C. resinicola* have the greatest host distribution of the genus. Hosts: *P. banksiana*, *P. contorta*, *P. elliottii*, *P. ponderosa*, *P. rigida*, *P. strobus*, *P. taeda* and *P. virginiana*. Distr.: coast to coast, Canada to Mexico and Florida, probably wherever pines naturally grow. Eaton & Yuill 1960, Reeks 1960.

6a Larva in enlarged, apical, foreshortened branchlet, see Images 77 and 78 .... cecidomyiid, possibly *Cembrotia* sp.

The entire swollen branchlet with surrounding needles is 1.5-2-0 cm long. Hidden among the needles at the very apex of the swelling is a tan, conical, structure, itself about 1 cm long, made up of many miniature stunted needles and their fascicles that can be peeled away to reveal a central chamber with a single larva. Galls were found in December with fully developed pupae. Host: *P. edulis*. Distr.: Utah, New Mexico.

6b Larva at base of needles, often causing foreshortening or bending 7
7a Needles usually of normal length, sometimes bent or discolored, occasionally slightly swollen at base 8
7b Needles much shortened, conspicuously enlarged at base 11
8a Larva embedded in swollen needle bases, Plate 81 (7) ..... *Thecodiplosis piniresinosae* Kearby

Eggs are laid singly or in clusters on elongating shoots in spring. One to several larvae develop in individual pockets at the base of a fascicle, between or around the needles. In Wisconsin, larvae mature by fall, drop to the soil and pupate in spring. Shortly after the larvae exit, the affected needles turn brown and drop. In heavy infestations, severe needle drop can cause branch mortality. Host: *P. resinosa*. Distr.: New York and Ontario to Minnesota. Kearby and Benjamin 1964.

8b Larva not embedded in needle tissue 9
9a On white pine, *Pinus strobus* ..... *Resseliella pinifoliae* (Felt)

Larvae are reportedly free at the base of the needle bundles, where they cause browning and needle drop in autumn after larvae dop to the soil. Similar damage to Scots pine, *Pinus sylvestris*, was also attributed to this species, but specimens from that collection were not preserved. Host: *P. strobus*. Distr.: Connecticut and Ontario.

9b On red pines, Plate 81 (8) 10

10a On red pine, *Pinus resinosae*, and Scots pine, *P. sylvestris* …… *Contarinia baeri* (Prell)

Eggs are laid in spring at bases of needles on new shoots. The yellow-orange larvae settle at the base of the needles. These then develop an elliptical yellowish area 2-6 mm long. The discolored area becomes brown after the larvae drop to the ground toward the end of summer. The opposite surface of the needle continues its growth so that the needle becomes bent. Larvae diapause in the soil and pupate the following spring. This species occurs also in Europe on *Pinus sylvestris*. It may be an immigrant. The earliest North American record is from New Brunswick in 1953. Hosts: *P. resinosa, P. sylvestris*. Distr.: New Brunswick to Ontario south to Pennsylvania and Michigan. Skuhravý 1973, DeBoo et al. 1975, Wilson et al. 1987.

10b On slash pine, *Pinus elliottii*, and loblolly pine, *Pinus taeda* …… …… *Contarinia acuta* Gagné and *Contarinia* spp.

C. acuta. Larvae feed at points along the surface of developing needles that are still within the sheath. Characteristic, 4 mm long, brown lesions are formed at the feeding sites and needle droop follows. After the full-grown larvae leave, the needles frequently break off at the lesion. Pupation occurs in the surface litter on the ground. This species may have as many as six generations per year and always oviposits on new flushes of needles. Hosts: *P. elliottii*, *P. taeda*. Distr.: Florida, Mississippi and Louisiana. Gagné and Beavers 1984, Weatherby et al. 1989.

Contarinia spp. Three unidentified species of this genus were noticed on new shoots of slash pine in Florida, but their feeding sites were not determined. Host: *P. elliottii*. Distr.: Florida. Gagné and Beavers 1984.

11a In eastern North America …… 12
11b In western North America …… 13
12a On Virginia pine, *Pinus virginiana*, Plate 81 (6), see Image 79 …… …… *Thecodiplosis brachynteroides* (Osten Sacken)

Infested needles are much shortened and usually coalesced basally. Galls are green to purplish and the two needles usually diverge. One to several reddish-orange larvae become embedded in the swollen needle bases. Full-grown larvae crawl out through the top of the gall and drop to the soil in early to late October. There is one generation per year, with pupation and adult flight occurring in early spring. Similar galls with larvae indistinguishable from those of *T. brachynteroides* were found on Austrian pine, *P. nigra,* in Connecticut in 2013. Hosts: *P. virginiana* and possibly *P. nigra*. Distr.: Connecticut to Virginia.

12b On pitch pine, *Pinus rigida* …… *Thecodiplosis pinirigidae* (Packard)

One or two larvae live in individual pockets between two of the three needles, which causes an uneven enlargement at their bases. The foreshortened needles are sometimes straight, sometimes recurved. Larvae drop to the ground in autumn. There is one generation per year. Larvae were originally reported to crawl out on the galls and form cocoons in which they

pupated, but this is the habit of *Cecidomyia piniinopis* (q.v.) with which *T. pinirigidae* was evidently confused. Host: *P. rigida*. Distr.: Maine.

13a On *Pinus edulis* or *Pinus cembroides* 14
13b On other species of pine 17
14a Needle fascicle swollen and misshapen, needles not developed beyond basal swelling, Plate 82 (8) ..... *Contarinia cockerelli* (Felt) and *Cembrotia* sp.

C. cockerelli. This species is known from a single female, reportedly reared from galls such as those illustrated on Plate 82 (8), although these normally contain a species of *Cembrotia*. The female has a strongly sclerotized, needlelike ovipositor. This species is placed in *Contarinia* only for temporary convenience. Host: *P. edulis*. Distr.: Colorado.

Cembrotia sp. The biology of this species is probably similar to that of *C. coloradensis* of entry 17a of this key. Swellings harbor two larvae or pupae, each in a separate depression. Host: *P. edulis*. Distr.: Colorado.

14b Needle fascicle swollen at base, shorter than normal 15
15a Larvae gregarious between needles, Plate 82 (7) .... *Pinyonia edulicola* Gagné and *Contarinia sp.*

P. edulicola. Pinyon spindle gall midge. Eggs are laid on developing needles in mid-June to mid-July. Upon hatching, larvae crawl to the base of the needles. The needles expand into a spindleform enlargement around a chamber housing 5-40 larvae. Larvae grow during the summer and the following spring. Pupation occurs in the gall and adults emerge in early summer. Infested needles drop off later the same year, 6-8 years prematurely. Hosts: *P. edulis, P. cembroides*. Distr.: Colorado, Arizona, New Mexico and Texas. Houseweart and Brewer 1972, Baskin and Brewer 1983.

Contarinia sp. On one occasion several young larvae were found in old galls of *P. edulicola*. Host: *P. cembroides*. Distr.: Texas.

15b Each larva in separate chamber 16
16a Larva encased in removable capsule, Plate 82 (10) ..... *Cembrotia coloradensis* (Felt)

Adults lay eggs on developing shoots in late May and early June. Ten or more larvae may enter the fascicle bundle, but usually only two, occasionally one or three, survive at the base of each needle bundle. Affected needles grow only to about one-third normal length, the base of the needle is enlarged, almost spherical, and the sheath enlarges to encase the gall. A detachable capsule made up of needle tissue simulating two dwarfed needles surrounds each larva. Larvae grow partially in summer and complete growth the following spring. Larvae then form a cocoon and pupate in the galls to emerge in May to early June. One generation occurs per year. Galled needles fall after the adults leave. Pinyon pine needles normally live 6-8 years. This species has been reported from *P. virginiana* (Felt 1940, 1965 and elsewhere), but the gall on that pine is formed by *Thecodiplosis brachynteroides*. Host: *P. edulis*. Distr.: Colorado, Arizona and California. Gillet and Brewer 1983, Russo 2021.

16b Larva encased in simple depression at base of needles, Plate 82 (9) …… …… *Cembrotia* sp. near *coloradensis* (Felt)

The biology of this species is similar to that of the related *C. coloradensis* of the following couplet, except that the larvae are not encased in detachable capsules. The needle base is not as strongly swollen as it is for *C. coloradensis*. Host: *P. edulis*. Distr.: Colorado. Brewer 1971.

17a On ponderosa pine, *Pinus ponderosa* var. *scopulorum* …… *Contarinia coloradensis* Felt

Eggs are laid on new needles. Larvae settle at the bases of the needles, where they form separate chambers. The fascicle remains short and becomes greatly swollen at its base. The orange larvae drop to the soil in late summer or early fall. Adults emerge in spring from pupae in the duff. Needles die and drop off after their first year instead of after the normal 6-8 years. Host: *P. ponderosa*. Distr.: Colorado. Brewer and Johnson 1977.

17b On other species of pine …… 18
18a On Monterey pine, *Pinus radiata* …… *Thecodiplosis piniradiatae* (Snow and Mills)

Eggs are laid on developing buds in January. Larvae crawl among the needles and cause them to become shortened and swollen at their bases. This species reportedly pupates on the plant in cocoons, but cocoons attributed to this species may be formed by a *Cecidomyia* and mistaken for this species. *Thecodiplosis* spp. normally drop to the soil to pupate so perhaps the larvae of *T. piniradiatae* dropped to the soil unnoticed. Browning of the needles is noticeable in the fall. Host: *P. radiata*; also, reportedly *P. coulteri*, *P. sabiniana*, *P. sylvestris* and *P. tuberculata*. Distr.: California. Snow and Mills 1900.

18b On *Pinus monophylla* …… *Cembrotia* spp.

Two kinds of fascicle galls, each caused by aa undescribed species of *Cembrotia*, are known from this host. The first causes a second needle to grow, while the other only shortens the single needle. Larvae of both live in individual chambers at the base of the fascicles, pupate in the fascicles in spring and cause premature needle drop. Host: *P. monophylla*. Distr.: Arizona.

Pseudotsuga (Douglas-fir)

1a Larva in cone …… 2
1b Larva in needle or twig …… 5
2a Larva in tunnel or chamber in cone scale …… 3
2b Larva between cone scales …… 4
3a Larva in spherical chamber in swollen cone scale, Plate 82 (11) … *Contarinia oregonensis* Foote

Douglas-fir cone gall midge. Adults emerge from the ground in April and May. Eggs are laid in clusters near the base of cone scales on newly opened flowers. Upon hatching, larvae

migrate along the inner surface of scales and become embedded singly in tissue, which begins to swell. In late summer or autumn, the full-grown orange larvae drop to the duff. Pupation and adult emergence occur the following spring. Host: *P. menziesii*. Distr.: British Columbia and Oregon. Hedlin 1961.

3b Larva in tunnels in apparently normal cone scale …… … *Contarinia washingtonensis* Johnson and *Camptomyia pseudotsugae* Hedlin and Johnson

C. washingtonensis, Douglas-fir cone scale midge. Eggs are laid on developing cones in May and June. Larvae live in tunnels among the cone scale fibers and can damage the scales and eventually kill the seeds. Full-grown larvae drop to the ground in late summer and fall. Pupation occurs in spring. Host: *P. menziesii*. Distr.: British Columbia to Oregon. Hedlin and Johnson 1963.

C. pseudotsugae. This species is an inquiline in tunnels of *C. washingtonensis*. It occurs only in cones infested by *C. washingtonensis* and lives in close association with it. Eggs are laid in May and June and the full-grown orange larvae drop to the duff in fall. Host: *P. menziesii*. Distr.: British Columbia to California. Hedlin and Johnson 1968.

4a Larva orange, with a spatula and pebbled skin …… *Resseliella coryloides* (Foote)

This species lives between cone scales and on developing seed surfaces. It is usually found in great numbers and may have more than one generation per year. Pupation occurs in the cone. Host: *P. menziesii* and other conifers. Distr.: western North America. Hedlin et al. 1980.

4b Larva white, smooth, without spatula …… *Asynapta hopkinsi* Felt

Larvae are usually gregarious and presumably feed on damaged cones. Full-grown larvae drop to the ground to pupate. Host: *P. menziesii* and other conifers. Distr.: widely distributed in North America. Hedlin et al. 1980.

5a Larva at base of needles in drop of resin …… *Cecidomyia* sp.

Larvae live immersed in resin. When full-grown, larvae crawl up a needle and form a cocoon in which they pupate. Host: *P. menziesii*. Distr.: Oregon.

5b Larva in needle, Plate 82 (12) …… 6
6a Only upper surface of needle discolored; needle often distorted or bent …… …… *Contarinia cuniculator* Condrashoff

This and the two species in couplet 7 differ only in minor details of their biology and anatomy. Larvae are white to yellow. In September they drop to the ground where they diapause. Pupation occurs in early spring. Adults emerge in May, fly upward along a tree trunk and mate near the periphery of branches. Eggs are laid on the upper surface of the needles. Infested needles usually contain one larva, but up to four have been found. All three

species can cause heavy needle loss. Host: *P. menziesii*. Distr.: British Columbia to California. Condrashoff 1961a, 1961b, 1962.

6b Both surfaces of needle discolored; needle usually not distorted or bent …… 7
7a Needle swollen surrounding feeding site (357) …… *Contarinia pseudotsugae* Condrashoff

This species appears to be the most serious pest of the three found in Douglas-fir needles. Its biology is generally similar to that of *C. cuniculator* (see entry 6a of this key) except that eggs are laid on the lower epidermis of the needles and larvae escape from the lower side of the needle. Up to 12 larvae can be found in one needle. Host: *P. menziesii*. Distr.: British Columbia to California, and Hidalgo. Condrashoff 1961a, 1961b, 1962.

7b Needle flattened surrounding feeding site …… *Contarinia constricta* Condrashoff

The biology of this species is also generally similar to that of *C. cuniculator* (see 6a) except that eggs are laid on the lower surface of the needles and larvae escape from the lower side. Usually one, occasionally two to three larvae are found in a needle. Host: *P. menziesii*. Distr.: British Columbia to California. Condrashoff 1961a, 1961b, 1962.

Tsuga (hemlock)

Larvae in foreshortened tips of branchlets …… *Contarinia* sp.

This species is known only from larvae associated with the damage. Each infested shoot has 5-12 larvae. Affected needles are red and may be folded or slightly wider basally. Host: *T. heterophylla*. Distr.: Vancouver I., British Columbia.

Plantaginaceae

Keckiella (keckiella)

Swollen stem …… *Lasioptera tibialis* Felt

This species may be an inquiline. It has been reared also from *Atriplex* sp. in association with a *Neolasioptera* gall. Adults were reared in April. Host: *K. antirrhinoides*. Distr.: California.

Penstemon (beardtongue)

Swollen, aborted flowers …… *Asphondylia* sp.

A single gall may be 1-2 cm in diameter and harbor many larvae, each in its separate chamber. Larvae pupate in the gall. Adults emerged in mid-April. Host: *P. clevelandii*. Distr.: California.

Veronica (speedwell)

Appressed leaves on shoot tips …… *Dasineura similis* Löw

Larvae are gregarious between the shortened appressed apical pair of leaves and pupate there inside cocoons. This species is an introduced insect, as is its host. Host: *V. serpyllifolia*. Distr.: Iowa, Eurasia. See on BugGuide.

Veronicastrum (Culver's root)

From stem …… *Neolasioptera* sp.

Host: *V. virginicum*. Distr.: Wisconsin.

Platanaceae

Platanus (sycamore)

Rolled leaf margin or distorted leaf …… *Prodiplosis platani* Gagné

Larvae feed gregariously on new leaf growth. When full-grown they either stay in place covered with leaf indumentum or drop to the soil. In either case they spin cocoons in which they eventually pupate. Several generations occur per year. Host: *P. occidentalis*. Distr.: New York to Florida. Neal and Gott 1988.

Poaceae

Grasses harbor a distinctive cecidomyiid fauna. Most native North American grasses may eventually be found to have a *Stenodiplosis* in the flowers and a *Calamomyia* in the stems. *Stenodiplosis* species attack flowers and prevent seed formation. *Calamomyia* spp. live inside culms, the only exterior sign of their presence being the black fungal excrescence associated with full-grown larvae that may show through to the exterior (as on Plate 83 (5) and viewable on BugGuide). *Astictoneura* spp., *Edestochilus allioides* (Pritchard) and *Chilophaga* spp. may cause at least a foreshortening of the stems with imbricated leaves resulting in a broom- or onion-shaped gall (as on Plate 83 (6-8). *Edestosperma aristidae* Gagné lives in seeds. The remaining cecidomyiids on grasses comprise several species of *Dasineura* (some possibly introduced from Europe in seed contamination), three described and at least two undescribed species of *Mayetiola* (including the introduced Hessian fly, a major scourge if wheat), *Sitodiplosis mosellana* (another introduced, major pest of wheat), a few *Clinodiplosis* spp. and several unidentified seed-infesting species not yet placed to genus.

Agropyron (see *Elymus*)

Agrostis (bentgrass)

Larva on inflorescence …… *Dasineura graminis* Felt

This species is based on adult females caught in early June while laying eggs on flower heads of its alien host, colonial bentgrass. It may be an introduced species. A *Dasineura* identified as *D. graminis* was reared from seeds of this host in England. It was feeding in flowers when seed was being formed. Host: *A. capillaris* (as *vulgaris*). Distr.: New York; probably Europe. Barnes 1946b, Fagúndez et al. 2020.

Alopecurus (foxtail)

1a Larva in floret …… *Stenodiplosis geniculati* (Reuter) and *Dasineura alopecuri* (Reuter)

Both species are immigrants from Europe. The first prevents seed formation, the second feeds on developing seeds. Larvae of both species overwinter in the host. Larvae of the *Stenodiplosis* have no spatula; those of the *Dasineura* have a spatula in the last instar; *S. geniculati* is multivoltine, *D. alopecuri* usually univoltine. Hosts: *A. arundinaceus*, *A. geniculatus* and *A. pratensis*. Distr.: South Dakota, New Brunswick and Ontario; Europe and New Zealand. Barnes 1946b, Boe 1991, Fagúndez et al. 2020.

1b Larva active on inflorescence …… *Clinodiplosis setariae* (Felt)

Larvae crawl freely among the flowers and may only be mycophagous, but have been found repeatedly on this and other grasses. Larvae drop to the soil to pupate. Several generations may occur per year. Hosts: *Alopecurus* sp.; also *Cenchrus* sp. Distr.: New York and Florida.

Andropogon (bluestem)

Larva in floret …… *Stenodiplosis wattsi (*Gagné*)* and unidentified cecidomyiids

S. wattsi. This species prevents seed development. Hosts: *A. gerardi*, *A. hallii*, *A. stolonifera* and *Schizachyrium scoparius*. Distr.: South Dakota, Nebraska, New Mexico and Florida. Watts and Bellotti 1967*,* Carter et al. 1988.

Unidentified cecidomyiids. These are known only from larvae found in seeds or florets in fall. Larval characters of one are shown on Plate 12 (1-2). Adults must be reared for further identification. Host: *A. gerardi*. Distr.: North Dakota, Kansas, Iowa, New York, Maine, Maryland.

Arctagrostis (wideleaf polargrass)

Abrupt stem enlargements, see Image 80 …… *Mayetiola* sp.

The gall midge is distinct from the Hessian fly, *Mayetiola destructor*. Its host is a circumpolar grass. Host: *A. latifolia*. Distr.: Alaska.

Aristida (three awn)

1a Larva in seed ..... *Edestosperma aristidae* Gagné

Adults were reared in spring from stored, apparently normal seed. Host: *A. purpurea*. Distr.: Idaho.

1b Larva in imbricated stem gall, Plate 83 (7) ..... *Chilophaga gyrantis* Gagné

Galls are usually found close to the base of the stem. Each contains several larvae, usually one at the base of each leaf sheath. Full-grown larvae form a cocoon and pupate in the gall. Several generations occur per year. Host: *A. gyrans*. Distr.: Florida. Gagné and Stegmaier 1971, Stegmaier 1973, Gagné and Figueroa 2022.

Bouteloua (grama)

Larva with seed, Plate 12 (10) ..... cecidomyiid

Larvae of this unidentified cecidomyiid collected with seeds in early October apparently belong to the supertribe Cecidomyiidi but cannot be identified further until adults are reared. Host: *B. curtipendula*. Distr.: Oklahoma.

Bromus (brome)

Larva in floret ..... *Stenodiplosis bromicola* (Marikovskij and Agafonova)

Bromegrass seed midge. This is evidently an immigrant species, discovered in the Great Plains as early as 1948 but described only in 1962 from Russia. It is at least bivoltine. Infestation rates can run over 50%. Hosts: *B. inermis*, *B. riparius*. Distr.: Great Plains from Saskatchewan and Wisconsin, south to Oklahoma. Neiman and Manglitz 1972, Curry et al. 1983.

Calamagrostis (reedgrass)

1a Enlarged stem base ..... *Mayetiola ammophilae* Gagné

The damage is similar to that made on wheat by the Hessian fly, *Mayetiola destructor*. Infestation promotes subsequent rot and lodging. Full-grown larvae pupate in the stems within the hard second instar integument. Two generations may occur per year. Host: *C. breviligulata*. Distr.: New Jersey.

1b Abrupt swelling just above a node ..... *Mayetiola* sp.

The gall resembles that found on *Mayetiola ventricola* on *Molinia in Europe* (S. Carbonnelle, in litt.). Adults emerge in spring. Host: *C. lapponica*. Distr.: Alaska. See on iNaturalist.

Cenchrus (sandbur)

Larva on inflorescence …… *Clinodiplosis setariae* (Felt)

Larvae crawl freely among the flowers. When full-grown they drop to the soil to pupate. Several generations probably occur per year. Hosts: *C. echinatus*; also *Alopecurus* sp. Distr.: New York, Florida.

Chasmanthium (Indian woodoats)

Larva in florets …… *Clinodiplosis* sp.

Larvae were collected in September and adults emerged in March of following year. Host: *C. latifolium*. Distr.: Oklahoma.

Cinna (woodreed)

Larva in apparently normal, sometimes discolored stem …… *Calamomyia* sp.

Host: *C. arundinacea*. Distr.: Maryland.

Danthonia (oatgrass)

Larva in apparently normal, sometimes discolored stem …… *Calamomyia danthoniae* (Felt)

Host: *Danthonia* sp. Distr.: New York.

Dichanthelium (rosette grass)

Larva in apparently normal, sometimes discolored stem …… *Calamomyia panici* (Felt)

This species is known from a single female caught in June while apparently laying eggs on its host. Host: *D. latifolium* (as *Panicum macrocarpa*). Distr.: New York.

Echinochloa (cockspur grass)

Larva in apparently normal, sometimes discolored stem …… *Calamomyia echinochloa* (Felt)

Host: *E. crus-galli*. Distr.: South Dakota.

Elymus (wild rye)

1a Larva in spikelet …… *Stenodiplosis* sp.

Hosts *E. repens*, *E. smithii*, *Elymus* sp. Distr.: Nebraska, Arkansas, Ontario.

1b Larva in stem … 2
2a Larva in imbricated stem gall (as on Plate 83 (8)) …… ?*Chilophaga* sp.

The stem is foreshortened and the leaves tightly imbricated. The gall maker is at present unknown. Host: *E. repens*. Distr.: Pennsylvania. Gagné and Figueroa 2022.

2b Larva in apparently normal, sometimes discolored stem or swollen stem base …… 3
3a Larva in apparently normal, sometimes discolored stem …… *Hybolasioptera elymi* Gagné

The occasional discoloration of the infested stem is evidently due to the black excrescence of a fungus associated with this gall midge. The large, orange, ovoid, full-grown larvae overwinter in the stems and pupate there in spring. Hosts: *E. glaucus* (as *americanus*) and *E. virginicus*. Distr.: Kansas, Iowa. See on BugGuide.

3b Larva in swollen stem base, as on Plate 83 (1-4) …… *Mayetiola destructor* (Say)

This species normally occurs on wheat, but wild rye and barley are accidental hosts. See under *Triticum* for further information. Hosts: *E. glaucus* (as *americanus*), *Triticum* spp. Distr.: North America, Europe, North Africa, wherever wheat is grown except Australia.

Eragrostis (lovegrass)

Larva in apparently normal, sometimes discolored stem …… *Calamomyia agrostis* (Felt)

Host: *E. minor*. Distr.: unspecified.

Hordeum (barley)

Larva in swollen stem base, Plate 83 (1-4) …… *Mayetiola destructor* (Say)

This species prefers wheat, but barley may also be infested. In the Old World the *Mayetiola* barley specialist is *M. hordei* Kieffer. That species is fortunately not yet known in North America. See under *Triticum* for further information about *M. destructor*. Hosts: *H. vulgare*, *Triticum* spp. Distr.: North America; Europe, North Africa. Gagné et al. 1991.

Muhlenbergia (muhly)

1a Imbricated stem gall, Plate 83 (8) …… …… *Astictoneura muhlenbergiae* (Marten) and *Chilophaga colorati* (Felt)

One to many larvae can be found between the foreshortened leaf sheaths forming the gall. Pupation occurs in the gall in spring. Larvae of the two species are distinct. That of *A. muhlenbergiae* has a smoothly rounded terminal segment (as on Plate 8 (5)); that of *C. colorati*, a terminal segment with two rounded projections (Plate 8 (1)). Hosts: *M. mexicana*, *Muhlenbergia* sp. Distr.: Connecticut to South Dakota and Iowa. Gagné and Figueroa 2022.

1b Swollen, deformed, aborted spikelet, see Image 81 …… cecidomyiid

Deformed spikelets collected in August each tightly enclosed a single, reddish-orange larva. Host: *M. cuspidata*. Distr.: Montana, North Dakota, South Dakota.

Panicum (panic grass)

1a Apparently normal, sometimes discolored stem …… *Calamomyia inustorum* (Felt)

Larvae inside the culm were found in elongate silken tunnels. A black fungal excrescence was evident on the inside of the culms. Host: *P. virgatum*. Distr.: South Dakota and Oklahoma.

1b Foreshortened peduncles and internodes …… *Chilophaga virgati* Gagné

This species causes a shortening of the peduncles and internodes so that infested plants are conspicuously shorter than normal. Orange, gregarious larvae may be found in large numbers in autumn inside the sheath of the flag leaf. Some larvae leave the tillers to fall to the ground, some do not. Pupation occurs the following spring. Host: *P. virgatum*. Distr. South Dakota. Boe & Gagné 2011, Gagné and Figueroa 2022.

Paspalum (crowngrass)

Foreshortened, swollen stem bases, Plate 83 (6) …… *Edestochilus allioides* (Pritchard)

Adults were reared from the swollen stems in August. Host: *P. distichum*. Distr.: California and Utah.

Phalaris (canary grass)

1a In aborted glumes …… *Coniophora graminicola* Nijveldt

This species is evidently an immigrant. Full-grown larvae drop to the soil. Host: *P. arundinacea*. Distr.: South Dakota, Minnesota, Wisconsin. Perilla & Johnson 2018.

1b In swollen stems …… *Mayetiola phalaris* Barnes

Originally known from Europe, this gall midge was recently reared one November from canary grass growing in a roadside ditch. The identification was made by S. Carbonelle (in litt.). Host: *P. arundinacea*. Distr.: Iowa. See on BugGuide.

Phragmites (reed)

The native American subspecies of *P. australis*, ssp. *americanus*, occurs inland and has at least one native cecidomyiid associated with it. The European subspecies, *australis*, an invasive pest that now occurs along the eastern provinces and states has its own European cecidomyiids that were

evidently introduced with it.

1a Larva in flower …… *Stenodiplosis phragmicola* Sinclair & Ahee

This species is so far known only from North America on both subspecies of reed. Host.: *P. australis*. Distr.: Quebec. Ahee et al. 2013.

1b Larvae in stem, sometimes causing slight swellings and discoloration …… *Calamomyia phragmites* (Felt), *Giraudiella inclusa* (Frauenfeld) and *Lasioptera hungarica* Möhn

C. phragmites. This is a native American species. Larvae are gregarious in internodal pith cavities. Exterior signs of injury are leaf yellowing and stunted growth. Host.: *P. australis*. Distr.: Michigan, New York. Frohne 1939.

G. inclusa and *L. hungarica*. These are European species evidently introduced with their host, ssp. *australis*, now present and expanding its range in North America. Both have two generations per year. The second species has a fungal associate. Host.: *P. australis*. Distr.: New York, New Jersey and Connecticut. Skuhravá & Skuhravý 1981.

Setaria (foxtail grass)

1a Larva in floret …… *Stenodiplosis* sp.

Host: *S. pumila* (as *glauca*). Distr.: unspecified.

1b Larva in culms …… *Chilophaga setariae* Plakidas

Host: *Setaria parviflora*. Distr.: Pennsylvania. Gagné and Figueroa 2022.

Sorghastrum (Indian grass)

1a Larva in apparently normal, sometimes discolored stem …… *Calamomyia* sp.

Host: *S. nutans*. Distr.: Maryland.

1b Larva in floret …… *Stenodiplosis* sp.

This species overwinters in a cocoon between the glumes. Host: *S. nutans*. Distr.: Nebraska, Iowa. See on BugGuide.

Sorghum (sorghum)

Larva in floret …… *Stenodiplosis sorghicola* (Coquillett) and *Clinodiplosis* sp.

S. sorghicola. Originally from Africa, this species was introduced into North America in the nineteenth century with seed of Johnson grass and sorghum. A major pest of sorghum, it has

several generations per year (9-12 in Texas) and prevents seed development. The third instar does not feed but remains for a time within the then brittle second instar skin until, depending on environmental factors, the third instar escapes to form a pupa within the flower head. Hosts: *S. bicolor* and *S. halepense*. Distr.: southern United States and Mexico, wherever the hosts occur; also worldwide wherever sorghum is grown. Barnes 1956, Harris 1964, 1970, 1976, Teetes 1985, Solinas 1986.

Clinodiplosis sp. An unidentified species, presumably a secondary invader, was discovered in sorghum florets in Michigan. Host: *S. bicolor*. Distr.: Michigan. Webster and Kohls 1972.

Sporobolus (cordgrass)

1a Larva in floret …… *Stenodiplosis spartinae* Gagné

In South Dakota females appear in mid-July through August and lay eggs in developing flowers. Larvae grow in developing ovules and seeds are aborted. Orange, full-grown larvae drop to the soil to overwinter. Hosts: *S. alterniflora* and *S. michauxianus*. Distr.: South Dakota, North Carolina. Perilla et al. 2015.

1b Larva in apparently normal, sometimes discolored stem, Plate 83 (5) …… …… *Calamomyia alterniflorae* Gagné and *Calamomyia* sp

C. alterniflorae. Host: *S. alterniflora*. Distr.: Maine and North Carolina. Gagné 1981.

Calamomyia sp. This species is distinct from *C. alterniflorae*. Host: *S. cynosuroides*. Distr.: North Carolina. Gagné 1981.

Tridens (tridens)

Larva in floret …… *Stenodiplosis albescentis (*Gagné*)*

Hosts: *T. albescens*, *T. flavus*. Distr.: South Carolina to northern Mexico.

Tripsacum (gamagrass)

Imbricated stem gall …… *Chilophaga tripsaci* (Felt)

Larvae live among the leaf sheaths. This species also feeds in tillers of *Zea mays* (q.v.) Hosts: *T. dactyloides*, *Zea mays*. Distr.: Texas, Michoacán. Gagné and Figueroa 2022.

Triticum (wheat)

1a Larva and puparia in stem swelling, Plate 83 (1-4) …… *Mayetiola destructor* (Say)

The Hessian fly. Eggs are laid on the upper surface of the leaf blade. Newly hatched larvae migrate to the base of a leaf sheath in 12-25 hours, settle and begin to feed. Most of the

feeding is done by the second instar larvae. The third instar, which does not feed, develops inside the second instar skin, which becomes hard and brittle. The third instar may undergo a diapause, after which it pupates in place. The pupa eventually breaks out of the second instar skin, allowing the adult to emerge. Several generations occur per year. Ears of infested plants become shriveled, and lodging occurs just above the nodes. This major scourge of wheat is an immigrant from Europe. The Hessian fly was so named because it evidently came to the New World during the Revolutionary War in straw used for forage and bedding by Hessian troops during the voyage to North America. The earliest infestation in North America was traced to Long Island, New York, where the troops disembarked (Fitch 1846). Hosts: *T. aestivum*, *T. turgidum*; also, occasionally *Elymus canadensis* in North America and other grasses as accidental hosts: *Agropyron repens* and *Agropyron smithii*; in Europe and North Africa it is occasionally also found on rye, *Secale cereale*, and barley, *Hordeum vulgare*, although *Mayetiola hordei* Kieffer is the species generally found on barley in Europe and North Africa. In New Zealand it has been reported also from *Bromus wildenowii*. Distr.: coast to coast in North America, wherever wheat is grown; Europe, Middle East, North Africa, New Zealand. Barnes 1956, Ertel 1975, Gagné and Hatchett 1989, Gagné et al. 1991, Harris et al. 2003.

1b Larva on developing flowers ……
… *Sitodiplosis mosellana* (Géhin), *Clinodiplosis* spp. and *Hyperdiplosis spiraeaflorae* (Felt)

S. mosellana. The wheat midge. This multivoltine immigrant from Europe is a major pest of wheat. The bright orange to brick red larvae live on developing flowers where they interfere with the proper development of the kernels. The second instar is the principal feeding stage of this species. The third instar develops inside the second instar skin and remains there without feeding until, depending on environmental factors, it eventually drops to the soil. The larva then spins a silken cocoon in which pupation occurs during either the same season or the following spring. Host: *T. aestivum*. Distr.: coast to coast in North America, probably wherever wheat is grown; Europe. Barnes 1956, Gagné & Doane 1999, Harris et al. 2003.

Clinodiplosis spp. The larvae of at least two unidentified species of this genus have been found in association with *S. mosellana* but little is known of their impact and biology. Adults of two species have been reared but were not associated with particular larvae. Host: *T. aestivum*. Distr.: Saskatchewan, North Dakota, Quebec. Gagné & Doane 1999.

H. spiraeaflorae. This species, its niche on wheat not exactly known, is evidently a secondary feeder. It has been associated also with flowers of *Campsis radicans* (Bignoniaceae) and *Spiraea alba* (Rosaceae). Host: *T. aestivum*. Distr.: New York, Maryland.

Zea (maize)

Stunted and wilted tillers, see Image 82 …… *Chilophaga tripsaci* (Felt)

Larvae live among the leaf sheaths. Damage to young maize by this species was recently found in September in western Mexico. The full-grown larvae pupated directly and adults emerged about two weeks later. Hosts: *Z. mays, Tripsacum dactyloides*. Distr.: Michoacán

and Texas. Gagné and Figueroa 2022.

Polemoniaceae

Phlox (phlox)

1a Stem swelling, sometimes inconspicuous ..... *Neolasioptera* sp.

Host: *Phlox pilosa*. Distr.: Iowa. See on BugGuide.

1b Larva in terminal buds, Plate 45 (8) ..... *Clinodiplosis phlox* (Greene)

Larvae are gregarious and live among the developing leaves in terminal and lateral buds. Affected buds are killed and infested plants have patchy flowers. This species begins feeding in early June and continues with several overlapping generations into October. The last generation of the season overwinters as full-grown larvae in the soil. Larvae of a generally similar *Clinodiplosis* were intercepted at a US port of entry on phlox flowers from The Netherlands. *Lestodiplosis maculipennis* Greene was found preying on the *Clinodiplosis*. Host: *Phlox* sp. and cultivars. Distr.: Ohio, Maine. Neiswander 1962.

Polygonaceae

Coccoloba (coccoloba)

Circular leaf blister, Plate 84 (1) ..... *Ctenodactylomyia watsoni* Felt

The monothalamous blisters have a slight nipple. Pupation takes place in the galls and several generations may occur per year. This species is probably the same as the earlier described *Ctenodactylomyia coccolobae* (Cook) from Cuba. Host: *Coccoloba* spp. Distr.: Florida, Mexico, West Indies. Mead 1970, Gagné 1994.

Eriogonum (buckwheat)

Swollen flower bud ..... *Prodiplosis falcata* Gagné

Adults were reared in spring from buds. Hosts: *E. latifolium*; also *Ericameria* sp. (Asteraceae). Distr.: California.

Fallopia (knotweed)

Ovate stem swelling ..... *Lasioptera* sp.

This cecidomyiid, known only from a larva, was listed by Felt (1940, 1965) as a *Lasioptera*, but may belong to the more speciose *Neolasioptera*. Host: *F. scandens*. Distr.: unspecified.

Persicaria (knotweed)

Greatly swollen leaf margin …… *Clinodiplosis* sp.

It is possible that the *Clinodiplosis* is only a secondary infection in these galls. Hosts: *P. hydropiperoides*, *P. lapathifolium*. Distr.: North Carolina and unspecified (for the latter of the two listed plant hosts).

Rumex (dock)

Deformed, reddish seed capsules …… …… *Contarinia acetosellae* (Rübsaamen) and *Contarinia rumicis* (Loew)

C. acetosella. This and the species below are introductions from Europe into North America during colonial times and occur on immigrant species of *Rumex*. Host: *R. acetosella*. Distr.: Illinois, Georgia and Florida; Europe.

C. rumicis Loew. Host: *R. crispus*. Distr.: New York; Europe.

Portulacaceae

Portulaca (purslane)

1a Succulent, tapered stem swelling, see Image 83 …… *Neolasioptera portulacae* (Cook)

Swellings are 12-36 mm long and 8-12 mm in greatest diameter. Adults emerge in July and August in Florida. Host: *P. oleracea*. Distr.: Florida, Mexico (unspecified); also West Indies, French Guiana and Colombia.

1b Swollen, unopened flower …… *Asphondylia portulacae* Möhn

Adults emerged in November and December in Florida. Host: *P. oleracea*. Distr.: Florida; also, West Indies and Central America to Argentina. Wünsch 1979.

Primulaceae

Lysimachia (yellow loosestrife)

1a Swollen terminal bud …… *Dasineura lysimachiae* (Beutenmüller)

The swelling is composed of inwardly rolled leaves. Larvae are gregarious. Full-grown larvae of at least the first generation form cocoons in the buds. Adults emerge soon after. Infested buds are usually killed. The damage appears similar to that caused by *Dasineura*

oxycoccana on cranberry; an early report (Smith 1890) noted that the two plants grow together. Hosts: *L. punctata*, *L. terrestris*. Distr.: New York, New Jersey, Pennsylvania and Indiana.

1b Clumped, spheroid apical galls, see Image 84 …… *Asphondylia* sp.

Several glabrous galls occur together at plant apices, each harboring a larva. Host: *Lysimachia* sp. Distr.: Virginia.

Ranunculaceae

Anemonastrum (anemone)

Slightly enlarged bud …… *Dasineura anemone* Felt

Damaged buds contain numerous, gregarious, orange larvae. Host: *A. canadense*. Distr.: New York.

Clematis (leather flower)

1a Tapered stem or tendril swelling …… *Neolasioptera clematidis* (Felt)

In Iowa galls may be found under bark at the base of stems. Hosts: *C. apiifolia*, *Clematis* sp. Distr.: Iowa, New York, Massachusetts and Quebec. See on BugGuide.

1b Swollen bud …… 2
2a Swollen white-woolly bud galls …… *Asphondylia clematidis* Felt

Swellings are subglobular, woolly, a little over 1 cm diam. and may be mono- or polythalamous. Galls appear in July and adult flies emerge in August. Host: *C. drummondii*. Distr.: Texas. Painter 1935.

2b Swollen, green leaf tips or flower buds …… 3
3a Tightly curled young leaf …… *Contarinia clematidis* Felt and *Dasineura clematidis* Felt

Adults of both species were reared in August from galls collected in July. One may be an inquiline of the other. Host: *C. apiifolia*. Distr.: New York to Maryland.

3b Enlarged flower bud …… *Prodiplosis floricola* (Felt)

Infested flower buds fail to open. Adults were reared in August in New York. This is a generalist species with wide host and geographic ranges. It is found elsewhere in eastern North America on *Asclepias* (Asclepiadaceae) and *Spiraea alba* (Rosaceae), also in Brazil on *Caryocar brasiliense* (Caryocaraceae) and *Citrus* (Rutaceae). Hosts: *C. apiifolia* and see above. Distr.: Widespread eastern USA and Brazil.

Hepatica (liverleaf)

In leaf petioles ..... *Neolasioptera* sp.

The damage is not obvious except for a slight blackening when larvae are fully grown. Hosts: *H. americana.* Distr.: Iowa. See on BugGuide.

Thalictrum (meadow-rue)

Irregularly enlarged seed pod ..... *Asphondylia thalictri* Felt

Infested seed pods are about 5 mm in diameter. Adults emerge from pods in August. A species of *Trotteria*, an inquiline, was also reared from these galls. Host: *Thalictrum* sp. Distr.: New Hampshire and Massachusetts.

Rhamnaceae

Ceanothus (ceanothus)

1a Bud or flower gall 2
1b Leaf gall 5
2a Pedicellate flower gall, Plate 84 (6) ..... *Asphondylia* sp.

Galls with pupae were collected in early August. Host: *C. velutinus*. Distr.: Montana.

2b Enlarged bud or leafy node gall 3
3a Enlarged, unopened flower bud, Plate 84 (3), see Image 85 ..... *Asphondylia* sp.

Galls are slightly hairy. Adults were reared in June and July. Hosts: *C. americanus*, *C. jepsonii*, *C. pauciflorus*, *C. thyrsiflorus*. Distr.: Idaho, Oregon and California.

3b Leafy node gall 4
4a Gall leaves linear, covering a central larval chamber, Plate 84 (4) … *Asphondylia ceanothi* Felt

Leaves making up the gall are slightly hairy basally, green at first, then brown. A single larva lives in a centrally placed chamber and pupates in place. Adults were reared in June, so possibly lay their eggs in the next year's buds. Host: *C. velutinus*. Distr.: Oregon and California. Russo 2021.

4b Gall leaves broad, larvae free at base of leaves ..... *Contarinia* sp.

Leaves of this gall are as broad as wide and do not enclose a single central chamber. Gregarious larvae live at the base of the leaves and drop to the soil when full-grown. Host: *C. fendleri*. Distr.: Arizona.

5a Spheroid gall below major vein, without slit on upper side, Plate 84 (5) …… *Asphondylia* sp.

Galls are more bulbous than those of the *Contarinia* spp. below and contain a single larva and its white fungal associate. Larvae pupate in the galls. Host: *C. velutinus*. Distr.: Montana. Russo 2021.

5b Elongate, simple vein fold or entire leaf folded longitudinally …… 6
6a Elongate folds along individual veins, Plate 84 (7) …… *Contarinia* sp.

Swellings are most visible on the underside of the leaf; a slit is evident along the vein on the upper leaf surface. Larvae are gregarious, orange when full-grown and escape through the slit between the leaf folds. This species may be bivoltine; adults appeared less than ten days after larvae left the current year's galls collected from *C. verrucosus* in mid-April in San Diego, Co., California. More than one species may be involved, inasmuch as the galls were found on both coasts of North America. Hosts: *C. americanus*, *C. integerimus*, *C. velutinus* and *C. verrucosus*. Distr.: Connecticut, Oregon and California. Russo 2021.

6b Entire leaf folded longitudinally, see Image 86 …… *Contarinia* sp.

The podlike leaf is folded from beneath and is usually purple. When the gregarious, orange larvae are full-grown the fold opens, allowing the larvae to drop to the soil. Host: *C. verrucosus*. Distr.: California.

Frangula (buckthorn)

Spheroidal, aborted flowers …… *Asphondylia* sp. and *Dasineura* sp.

Asphondylia sp. Galls are 6-8 mm in diameter, have an apical nipple, are light green and framed by the closed sepals. They are spongy, crimson red on the inside and bear a number of individual larval chambers placed parallel to the plant axis. Normal fruit are dark green to purplish-black and solid. This gall is similar to the one on *Ceanothus*. The *Dasineura* larvae found in the galls were presumably inquilines. Host. *F. californica*. Distr.: California.

Rhamnus (buckthorn)

Modified, pedicellate, aborted flower, see Image 87 …… *Asphondylia* sp.

Galls are red except for the yellow tip. One larva lives in the single chamber. The gall resembles the one on *Ceanothus*. Host. *R. crocea*. Distr.: California.

Rosaceae

Adenostoma (chamise)

1a Larva in aborted, tightly closed flower bud, see Image 88 … *Bruggmanniella adenostoma* Felt

Single larvae live in a chamber inside developing flowers that persist on the plant as brown, spheroid or cylindrical galls Adults emerge from the galls in spring. Host: *A. fasciculatum*. Distr.: California.

1b Starburst galls made up of many individual bracts …… cecidomyiid

Larvae, usually single, live in a chamber at the base of the gall. Host: *A. fasciculatum*. Distr.: California.

Agrimonia (agrimony)

Swollen flower …… *Contarinia agrimoniae* Felt

This species was reared in early September from larvae found in August. It is presumably multivoltine. Hosts: *A. striata*; also *Rubus* sp. Distr.: New York, Virginia.

Amelanchier (serviceberry)

This genus is host to various complex leaf galls, some of bizarre shape, made by species of *Blaesodiplosis*, a genus that also occurs on *Crataegus*. The group will require comprehensive study not attempted here. A sample of galls from the USNM collection is shown on Plate 85 (1); others are illustrated in Wells (1921b), Russo (2021) and Eiseman (2022, 2025a). Galls sometimes occur in such numbers as to cover the surface of a leaf. Each gall contains a single larva that departs from an opening on one side of the leaf when full-grown. All are presumably univoltine. Adults are known of only one species, *Blaesodiplosis canadensis*.

1a Enlarged fruit without stone …… *Contarinia* sp.

Infested fberries grow faster and larger than normally, lack stones and soon drop. This species is univoltine and the larva overwinters in the soil. Adults have not been reared. Similar damage is done to *Prunus* spp. by *Contarinia virginianiae* (q.v.). Hosts: *A. canadensis*, *Amelanchier* sp. Distr.: New York, Massachusetts.

1b Leaf galls …… 2
2a Circular, reddish blisters …… *Contarinia* sp.

Hosts: *A. canadensis*, *Amelanchier* sp. Distr.: Montana, Maine.

2b Pouch-shaped leaf galls …… 3
3a Tubular, lipped galls, Plate 85 (1d) …… *Blaesodiplosis canadensis* (Felt)

The gall illustrated here for this species is slightly different from that described by Felt in that this one protrudes about 5 mm from both sides of the leaf instead of only from the bottom. Host: *A. canadensis*. Distr.: Massachusetts and New York.

3b Gall conical, lipped on upper surface of leaf, convex and white-haired below, Plate 85 (1b) …… ……. *Blaesodiplosis* sp. and *Clinodiplosis canadensis* (Felt)

The *Clinodiplosis* was presumably a secondary feeder in the galls. Host: *A. canadensis*. Distr.: Massachusetts.

Cercocarpus (mountain mahogany)

1a Enlarged bud, Plate 85 (2) …… *Dasineura cercocarpi* Felt

Adults were reared in April in Colorado. Galls in southern California contained second instar larvae in mid-August. Hosts: *C. montanus*, *Cercocarpus* spp. Distr.: Colorado, Oregon and California.

1b Elongate vein swelling on upper surface of leaf, only a fold underneath, see Image 89 …… cecidomyiid

Larvae drop to the soil when full-grown. Host: *C. montanus*. Distr.: California.

Crataegus (hawthorn)

As with *Amelanchier* this genus also hosts leaf galls made by *Blaesodiplosis* spp.

1a Circular leaf spot, Plate 85 (3a) …… *Lasioptera excavata* Felt

Spots are pale green to purplish, often surrounded with red, and found in summer. An adult was reared in August. Host: *Crataegus* sp. Distr.: New York.

1b Vein swelling or complex leaf gall …… 2
2a Swelling with tubular papillae on at least one surface …… 3
2b Swelling smooth, at most with short hair …… 4
3a Gall globular, lip of opening surrounded with fringe of numerous, fine papillae, Plate 85 (3b) …… *Dasineura crataegibedeguar* (Osten Sacken)

Galls develop in early spring, are monothalamous and 4-5 mm in diameter. They usually appear on the leaf lamina, occasionally also on the petiole or at the tip of young twigs. Those on the leaves open most often on the upper leaf surface. Larvae develop quickly and in spring drop to the ground, where they enter diapause until the following year. The pea-shaped gall with the pointed apex reported and figured in Felt (1940, 1965) belongs to this species; the tubular growths on a gall do not always appear until after the gall reaches its ultimate size. Hosts: *C. pruinosa*, *C. succulenta*, *Crataegus* spp. Distr.: Massachusetts to Virginia, west to Illinois, including Ontario. Wellhouse 1922.

3b Gall cylindrical, covered basally with nippled bumps and spiny processes …… *Dasineura* sp.

Unlike other complex galls of hawthorn leaves, this one is detectable only on one side of the leaf and resembles a pineapple. It is green or red, about 3 mm in diameter, 5 mm high and usually on the upper surface of the midvein. The gall maker is known only from a series of larvae from Illinois. Hosts: *C. punctata* and *Crataegus* sp. Distr.: New York and Illinois. Wellhouse 1922.

4a Gall resembling a cockscomb, bilaterally flattened, wavy, yellow or red, Plate 85 (3d) ..... *Blaesodiplosis crataegifolia* (Felt)

This gall begins development in spring, but larvae grow slowly. In summer, the full-grown larvae drop to the soil, where they enter diapause until the following spring. A *Lestodiplosis*, a predator, was taken from these galls. Hosts: *C. macrosperma*, *C. mollis*, *C. pruinosa*, *Crataegus* sp. Distr.: Massachusetts to Ontario, south to Virginia. Wellhouse 1922.

4b Gall a simple, convex swelling, either hemispherical or cylindrical and tapering, occasionally tinged with red 5

5a Gall hemispherical, Plate 85 (3e) ..... *Blaesodiplosis venae* (Stebbins)

Galls and larvae develop quickly in early spring. Galls are monothalamous, 5-8 mm in diameter, usually slightly longer than wide and most often open on the upper leaf surface. The same species may also be responsible for the elongate, tapered swelling in entry 5b. Full-grown larvae drop to the soil to diapause until the next spring. Hosts: *C. punctata*, *Crataegus* sp. Distr.: Massachusetts, New York, Virginia and Oregon.

5b Gall cylindrical and tapering, Plate 85 (3c) ..... *Blaesodiplosis* sp.

These galls may also be made by *B. venae*. Both cylindrical and hemispherical galls may occur on the same leaf, but the former tend to have slightly thicker walls. Their variable length possibly depends on the number of larvae in the gall. Hosts: *C. punctata*, *Crataegus* sp. Distr.: New York, Virginia and Oregon. Larew and Capizzi 1983, Wellhouse 1922.

Fragaria (strawberry)

1a In cavity of fruit surrounded by woody tissue ..... *Dasineura* sp.

Up to 3 larvae were found in a berry. Host: *Fragaria* sp. Distr.: Maine.

1b Petiole swelling 2

2a Kidney-shaped swelling at base of petiole 1-2 cm long ..... ``*Cecidomyia" reniformis* Stebbins

Galls are red, 1-2 cm in diameter, nearly as long as broad and attached by their side or end at the base of petioles. Several spherical, hard-walled chambers, each usually bearing a single larva, are embedded in the light-colored pith. Adults have not been reared; larvae belong to Cecidomyiidi but have not been placed to genus. Host: *F. virginiana*. Distr.: Massachusetts.

2b Elongate, red swelling of petiole, see Image 90 ..... cecidomyiid

This gall may be only a different manifestation of "*C.*" *reniformis*. Host: *F. virginiana*. Distr.: Massachusetts.

Geum (avens)

1a In stems and petioles ..... *Neolasioptera* sp.

Affected petioles and stems may show some blackening when larvae are present. In petioles, especially, little swelling is apparent. Host.: *Geum* sp., probably *canadense*. Distr.: Iowa. See on BugGuide, See on BugGuide.

1b Tightly folded basal leaves ..... *Dasineura* sp.

The crimped and hairy leaves were found in October. Gregarious larvae live inside the folds. Host.: *Geum* sp., probably *canadense*. Distr.: Iowa. See on BugGuide.

Holodiscus (oceanspray)

Swollen leaf vein fold, Plate 86 (13) ..... *Dasineura* sp.

Folds are 5-10 mm long. Only a slit shows on the upper side of the leaf; on the lower side the galls are convex and yellowish. Full-grown larvae escape through the slit on the upper side. Host: *H. disc*olor. Distr.: Oregon.

Malus (apple)

In curled leaf ..... *Dasineura mali* (Kieffer) and *Dasineura* sp.

D. mali. This species is an immigrant from Europe, first recorded in North America in 1928 from Massachusetts. Its biology is similar to that of *D. pyri* on pear (q.v.). Host: *M. domestica*. Distr.: New Brunswick, New England, New York and Washington. MacPhee and Finnamore 1978, Gagné & Harris 1998, Harris et al. 1999.

Dasineura sp. This item was reared on one occasion in New Brunswick, Canada, from damage typical of that of *D. mali*. It could be a *Macrolabis*; the two genera cannot be distinguished from larvae alone. *Macrolabis mali* Anfora from Italy was found in association with *D. mali*, so the specimen from New Brunswick might possibly be the same. Host: *M. domestica*. Distr.: New Brunswick.

Oemleria (oso berry)

Swollen, rolled or curled terminal leaves ..... *Dasineura* sp.

Each tightly rolled leaf contains many gregarious larvae. Galls were found in mid-February to May. Full-grown larvae dropped to the soil in spring. Host: *O. cerasiformis*. Distr.

Washington, California.

Photinia (Christmas berry)

Aborted berries …… *Asphondylia photiniae* Pritchard

Berries are slightly swollen, sterile and remain green through the winter instead of turning the normal red. The damage is analogous to that of *Asphondylia ilicicola* on holly berries. Adults emerge from berries in early spring. Host: *H. arbutifolia*. Distr.: California.

Physocarpus (ninebark)

1a Leaf gall …… 2
1b Seed or bud gall …… 3
2a Pea-sized, globular, succulent, creamy-white gall, the slitlike opening lined with white hairs……
…… *Contarinia* sp.

Galls are visible chiefly on the upper surface of the leaves. They develop in May and early June. Adults of this gall midge have not been reared but could be the same species as a globular inflorescence gall maker in couplet 3b. Host: *P. opulifolius*. Distr.: Pennsylvania. Wheeler and Hoebeke 1985.

2b Elongate, hard, vein swelling, the slitlike opening without hairs …… cecidomyiid

Galls develop in spring and are visible chiefly on the upper surface of the leaves. Full-grown larvae and adults of this species are unknown. Similar galls have been found in both Oregon and Pennsylvania, but without adults we cannot know if they are made by the same species. Host.: *P. opulifolius*, *P. capitatus*. Distr.: Pennsylvania, Oregon. Wheeler and Hoebeke 1985.

3a Deformed seed …… *Dasineura* sp.

Host: *Physocarpus* sp. Distr.: Oregon.

3b Spheroid, light-yellow inflorescence gall, see Image 91 …… *Contarinia* sp. and *Lasioptera* sp.

Contarinia larvae are the more numerous in samples, but *Lasioptera* larvae are occasionally found with them. The gall is a soft, spongy, swollen pedicel, usually with aborted ovaries visible apically. Galls are often multi-chambered with one larva in each chamber. Full-grown, yellow larvae drop to the soil in early June. Host: *P. opulifolius*. Distr.: Pennsylvania, West Virginia. Wheeler and Hoebeke 1985.

Potentilla (cinquefoil)

Swollen stem or petiole, see Image 92 …… *Neolasioptera potentillaecaulis* (Stebbins)

This species was originally described from a stem gall but may also be responsible for the

petiole gall shown. The gall maker is only tentatively placed in *Neolasioptera* as adults are still unknown. Host: *P. canadensis*. Distr.: Massachusetts. Eiseman & Blyth 2022.

Prunus (plum)

1a Swollen, aborted fruit, Plate 86 (2) .... *Contarinia virginianiae* (Felt) and *Dasineura pergandei* Felt

C. virginianiae, chokecherry midge. Infested fruit are variously shaped, grow to twice normal size and do not develop a stone. Larvae live gregariously in the empty interior and drop to the ground when full-grown. Pupation occurs the following spring. Larvae closely resemble *C. racemi* and *C. cerasiserotinae*, the other two contarinias on *Prunus*. Several other gall midges have been reared from infested fruit, or at least from containers in which the fruit were held. These include: *Clinodiplosis canadensis* (Felt) and *Rhizomyia absobrina* (Felt), both presumably fungivores, and *Arthrocnodax cincta* (Felt), a mite predator. Hosts: *P. serotina*, *P. virginiana*, *Prunus* sp. Distr.: Ontario to Maine and south to Virginia and Alaska, Manitoba, Idaho, Utah and Arizona.

D. pergandei. This species was reared once from enlarged fruit and may be an inquiline. Host: *P. virginiana*. Distr.: Colorado.

1b Swollen rachis, bud, leaf or stem 2
2a Swollen rachis, Plate 86 (1) ..... *Contarinia racemi* (Stebbins)

Swellings are green, soft, 1-3 cm long, 0.5-1 cm in diameter. Larvae live among tunnels in the swollen rachis. Full-grown larvae drop to the ground, where they presumably diapause until the following spring. Hosts: *P. virginiana*, *P. serotina*. Distr.: Massachusetts to Florida.

2b Stem, leaf or bud gall 3
3a Scabrous swellings along swollen stem, see Image 93 ..... cecidomyiid

Host: *Prunus* sp. Distr.: Quebec.

3b Leaf or bud galls 4
4a Leaf fold, swelling, or pouch gall 5
4b Swollen or deformed bud 8
5a Elongate, narrow, club-like invagination of leaf, Plate 23 (3), gall of *Phytoptus cerasicrumena* Walsh (Acarina: Eriophyidae) ..... *Contarinia* sp. and *Dasineura* sp.

The gall is formed by the mite, but gall midge larvae can be found alongside the mites in some galls in May and June, presumably feeding on plant tissue. By mid-June the cecidomyiid larvae escape the galls to pupate in the soil. Host: *P. serotina*. Distr.: Maryland (the *Dasineura* sp.), West Virginia (the *Contarinia* sp.).

5b Leaf with simple fold or entire leaf furled and podlike 6
6a Simple leaf fold ..... *Dasineura* sp.

Felt (1907d, 1917) attributed the gall to *Mycodiplosis thoracica* (Fitch) (as *Mycodiplosis cerasifolia* Felt), but that species is a fungivore and presumably a secondary contaminant. The white larvae of his collection that he retained from characteristic leaf rolls belong to *Dasineura*, the presumed gall maker. Host: *P. virginiana*. Distr.: New Jersey.

6b Entire leaf furled, hard, podlike or midrib enlarged, succulent 7
7a Leaf entirely furled, hard, podlike, Plate 86 (4) ..... *Putoniella gracilis* Gagné

The two halves of a leaf form a hard capsule. Larvae are gregarious. The gall eventually develops a longitudinal slit on the upper side through which full-grown larvae escape. Swellings appear on new leaves in May and larvae depart in June. This species is univoltine. Host: *P. angustifolia*. Distr.: Georgia. Gagné and Payne 1992a.

7b Succulent longitudinal swelling of midrib, especially prominent on underside, see Image 94 ... . *Parallelodiplosis* sp.

As larvae mature, the upper surface of the leaflet opens and larvae drop to the soil. Host: *P. mexicana*. Distr.: Oklahoma.

8a Swollen terminal bud, Plate 86 (3) ..... *Contarinia cerasiserotinae* (Osten Sacken)

Swollen buds are ovoid, 1-2 cm long and up to 1 cm in diameter. The swelling is soft and often bright red when it appears at the time the buds are leafing out in early spring. Leaves beyond the swelling and the bud usually die. Multiple branches may later appear below the base of the gall. Larvae live gregariously in a central chamber and drop to the ground when full-grown. Adults emerge the following spring. Host: *P. serotina*. Distr.: New York and Massachusetts to Virginia, and Nebraska.

8b Leafy, cabbagelike, apical bud gall ..... *Contarinia* sp. and cecidomyiid

Contarinia sp. Galls appear in May and June. Larvae live freely at the base of the leaves and drop to the ground, presumably to diapause. Larvae of a *Clinodiplosis* were found feeding on the *Contarinia* larvae. Host: *P. angustifolia*. Distr.: Alabama, Georgia.

Cecidomyiid. This undescribed species, possibly a *Lopesia* sp., may be responsible for the gall. Its yellow larvae live in individual chambers at the base of the gall. Host: *P. angustifolia*. Distr.: Alabama, Georgia.

Purshia (bitterbrush)

1a Deformed flower receptacle, Plate 86 (5-6) ..... cecidomyiid

Infested flowers are aborted, the receptacles enlarged. Full-grown larvae in larvaria/puparia (the second instar larval skin) were found in the plant in August. Adults have not been reared. Host: *P. tridentata*. Distr.: Montana to Oregon.

1b Spheroid, filamentous node gall, Plate 86 (7) ..... *Contarinia* sp.

Galls are monothalamous, yellow to brown. Larvae belong to *Contarinia* only in the broad sense. Adults have not been reared. Host: *P. tridentata*. Distr.: Montana to Oregon.

Pyrus (pear)

1a Enlarged, sterile fruitlet, Plate 85 (6) ..... *Contarinia pyrivora* (Riley)

Pear midge. Infested fruit grow more quickly than normal to about l cm long, at which time the full-grown, yellowish, gregarious larvae drop to the ground. The larvae enter diapause until the following spring. This is an immigrant from Europe, first discovered in North America in 1877 on introduced stock in Connecticut. Host: *P. communis*. Distr.: formerly widespread in northeastern United States and eastern Canada; Europe, New Zealand. Barnes 1948a, Gagné & Harris 1998.

1b Curled leaf, Plate 85 (5) ..... *Dasineura pyri* (Bouché)

Eggs are laid on opening leaf buds in spring. Feeding by the gregarious larvae causes the leaves to curl under along the length of the midrib. Infested leaves drop prematurely after full-grown larvae exit. Several generations occur per year. This species is an apparent immigrant from Europe found in North America, initially in Connecticut in 1927. Host: *P. communis*. Distr.: Connecticut, New York and Washington. Barnes 1948a, Gagné & Harris 1998.

Rosa (rose)

1a Bud galls 2
1b Leaf galls 3
2a Curled and stunted bud, Plate 86 (10) ..... *Dasineura rhodophaga* (Coquillett)

This gall midge is a pest of cultivated roses. It has several overlapping generations, each of which can be as short as two weeks. Populations build up until early fall. Full-grown larvae leave the damaged tips, after which the buds wither, blacken and die. The last seasonal generation overwinters in the ground in cocoons and emerges the following spring. Eggs are laid inside the sepals of flower buds or leafy tips. Hosts: cultivated roses. Distr.: widespread in North America; possibly Europe also. Smith and Webb 1976.

2b Large, rosette gall, Plate 86 (9) ..... *Dasineura rosacea* (Felt)

Galls are 2-3 cm long and wide. Host: *Rosa* sp. Distr.: Manitoba, South Dakota, Illinois and Pennsylvania.

3a Folded or curled leaflets, Plate 86 (11) ..... *Contarinia* sp. and *Dasineura* sp.

The single adult specimen reared from this damage in New York was first provisionally identified by Felt (1908) as *Dasineura rosarum* (Hardy). This is a European species that causes similar damage to roses in Europe but the identification has not been confirmed. Taken also from the same leaflets initially were three larvae of a *Contarinia*. Both genera contain species that roll leaves on various plants. *Dasineura* larvae were found in such galls in western North America; in late August they were full-grown and dropping to the ground. Hosts: *R. arkansana*, *R. carolina*, *Rosa* sp. Distr.: New York, Massachusetts, British Columbia to Oregon, and North Dakota.

3b Fuzzy vein swellings, Plate 86 (12) ..... *Blaesodiplosis* sp.

Adults of this species have not been reared; larvae are tentatively placed in *Blaesodiplosis*. Galls are formed by an out-pocketing along the vein of a leaflet. Full-grown larvae leave the gall through a slit on the lower side of the leaflet. Host: *Rosa* sp. Distr.: Oregon.

Rubus (blackberry)

1a Damaged flower buds and newly opened flowers .....
..... *Contarinia agrimoniae* Felt and *Dasineura rubiflorae* Felt

C. agrimoniae. Larvae are gregarious and eventually drop to the soil to pupate. Adults appear less than two weeks later, but some larvae may enter extended diapause and emerge only the following spring. Host: *Rubus* spp.; also, *Agrimonia*. Distr.: New York, West Virginia and Virginia. Stiles et al. 1996.

D. rubiflorae. Larvae were found in May and adults were reared the following spring. Larvae destroyed the affected buds. This species has evidently not been reported since 1886. Host: *Rubus* sp. Distr.: Virginia.

1b Stem or leaf gall 2
2a Swollen stem, Plate 87 (2) ..... *Neolasioptera nodulosa* (Beutenmüller)

Swellings are usually on the smaller, apical branches and sometimes strongly ridged. Larvae were observed in November in West Virginia actively digging an exit passage that ended just before the outer bark. The larvae would then have retreated, entered diapause and emerged the following spring, as is typical for most temperate zone species of that genus. Hosts: *R. allegheniensis*, *R.* "*villosus,*" *Rubus* sp. Distr.: Massachusetts, New York and Ontario, west to Illinois, south to Florida. Eiseman 2025a.

2b Leaf gall 3
3a Petiole swelling ..... *Neolasioptera* sp.

Swollen petioles turn red. Larvae inhabit discrete elongate-ovoid chambers, several chambers to a swelling along the petiole axis and with white mycelium apparent. Larvae are distinct from those of *N. nodulosa* and *N. farinosa* that are also found on *Rubus*. Host: *Rubus* sp. Distr.: Ontario.

3b Galls on lamina 4
4a Simple, smooth, marginal or vein folds 5
4b Warty swelling or filamentous outgrowth 6
5a Marginal leaf roll ..... *Camptoneuromyia rubifolia* Felt

Although attributed to this species, of which one female was reared, the gall maker is probably either a *Dasineura* or a *Contarinia*, which are responsible for most leaf rolls. *Camptoneuromyia* spp. are inquilines and not otherwise known to be responsible for any galls. Host: *Rubus* sp. Distr.: Massachusetts.

5b Folded, deformed leaf base, Plate 87 (1) ..... *Dasineura plicatrix* (Loew) and *Dasineura* sp.

D. plicatrix. This is an alien, oligophagous species. Adults appear in spring and lay eggs in unopened leaf buds. Larvae feed gregariously in interstices on the furled leaves until they drop to the soil. Another generation appears in late summer. Host: *Rubus* spp., commercially grown varieties. Distr.: British Columbia; Europe. Sinclair et al. 2009.

Dasineura sp. This species is distinct from *D. plicatrix*, but its damage and biology are generally similar. It was found on a native *Rubus* while *D. plicatrix* is found on commercial varieties. Larvae are gregarious. When full-grown they form cocoons on the leaf and pupate there a short time later. Several generations may occur per year; full-grown larvae of the last generation would presumably drop to the soil before forming a cocoon. Adults were reared in September from larvae found in late August. Host: *Rubus parviflorus*. Distr.: Oregon.

6a Warty, mealy swelling, Plate 87 (3) ..... *Neolasioptera farinosa* (Osten Sacken)

Swellings occur on the leaf lamina, veins or petiole. They are soft and fleshy in summer but become woody by late fall. Larvae overwinter in the leaves and pupate in spring. Host: *R. allegheniensis*, *R. flagellaris*, *Rubus* sp. Distr.: Massachusetts to Ontario, south to Florida. Eiseman 2025a.

6b Spheroid, filamentous outgrowth, Plate 45 (5) .....
..... *Diplolepis rosae* (Linnaeus) (Hymenoptera: Cynipidae)

This gall-wasp deformation is treated here only because it was for a time attributed to a cecidomyiid as ``*Cecidomyia" muscosa* Stebbins, a name now synonymous with that of the wasp. Galls found in August were 1 cm in diameter, green at first, then brown, and occurred at the juncture of leaflets or on midveins. Host: *R. allegheniensis*, *R. eglanteria* and *R. rugosa*. Distr.: eastern North America and Europe.

Sorbus (mountain ash)

Pea-shaped swelling on leaf midrib, Plate 86 (8) ..... cecidomyiid

Swellings are mainly on the underside of leaflets. Full-grown larvae leave the galls through

the longitudinal, slit-like opening that develops on the upper side. Host: *S. decora*. Distr.: New York.

Spiraea (spirea)

The host of Felt's several species on spirea was given as *S. salicifolia*, evidently in error for *S. alba*. *Spiraea salicifolia*, upon which I have never seen galls, is an ornamental Eurasian introduction into North America. Only one gall midge, *Tavolgomyia karelini* (Fedotova) is known from spirea in the Palearctic Region. It is found in vegetative tips of *Spiraea hypericifolia* in Kazakhstan and Georgia (Skuhravá 2021). Gall midges on this plant are unknown in western Europe (Roskam 2019, Skuhravá and Skuhravý 2021).

1a On slightly enlarged, reddened flowers …… …… *Prodiplosis floricola* (Felt) and *Clinodiplosis spiraeaflorae* (Felt)

P. floricola. Infested flower buds fail to open. Larvae drop to the soil when full-grown. Adults were reared in August. This is a generalist phytophage with wide host and geographic ranges. It is found elsewhere in eastern North America on *Asclepias* (Asclepiadaceae) and *Clematis* (Ranunculaceae), and from Brazil on *Caryocar brasiliense* (Caryocaraceae) and *Citrus* (Rutaceae). Hosts: *S. alba* and other flora as noted above. Distr.: Widespread eastern USA and Brazil.

C. spiraeaflorae. An adult was reared once in August. This species is presumably a secondary feeder and distinct from *C. spiraeina*, another *Clinodiplosis* taken from this host. Host: *S. alba*. Distr.: New York.

1b On other plant parts …… 2
2a Bud galls …… 3
2b Stem or leaf galls …… 5
3a Agglomeration of individual galls, usually in a starburst arrangement, see Image 95 …… …… "*Cecidomyia*" *lappa* Stebbins and *Clinodiplosis spiraeina* (Felt)

"*Cecidomyia*" *lappa*. Spheroid clusters at the apices of branches or nodes may contain more than 70 separate galls, but smaller agglomerations of only two to five galls may be found along branch nodes (Plate 87 (6)). Galls are fully revealed by late June when larvae have not yet progressed beyond the first instar. One to three robust, red to red-orange larvae up to 7 mm. long can be found in a chamber at the base of each separate gall in early to mid-August before they drop to the soil to overwinter. This species is thus far known only from larvae. Host: *S. alba*. Distr.: New England.

Clinodiplosis spiraeina. An inquiline in cluster galls of spirea, this species was once believed to be the cause of the starburst gall. It has also been reared from "*Hormomyia" clarkei* Felt galls on spirea. Gregarious larvae of this species were recently taken from chambers of starburst galls from which larvae of the gall maker had already left. Host: *S. alba*. Distr.: New England.

3b Ovoid, non-leafy bud gall or single, leafy rosette 4
4a Ovoid, axial or terminal bud gall formed by bracts enclosing a larval chamber (see Image 96, 97) ..... "*Hormomyia*" *clarkei* Felt and *Clinodiplosis spiraeina* (Felt)

"*Hormomyia*" *clarkei*. This species is known only from larvae that cannot be placed to genus. Axial galls on *S. alba* in New England can be found in June and terminal galls in late August and early September. They are usually dark red with bud scales well-appressed along their edges. Galls are about 5 mm long and contain usually one, occasionally two, large, orange or red larvae that can reach nearly 6 mm long. In the Pacific Northwest, two generally similar galls have been reported (Russo 2021). The gall on *S. douglasii* is ovoid, about 5 mm long, green, with some basally flared bracts, while that on *S. splendens* is larger, cylindrical, 12 mm long, mostly maroon and with long, apically flared bracts. Whether the gall shape is indicative of a species complex in these galls cannot be determined at this time. Hosts: *Spiraea* spp. The larval specimen from reddish, purplish or green leaf buds in Massachusetts upon which Felt (1940, 1965) based his mention of an *Asphondylia* sp. belongs to *H. clarkei*. Hosts: *Spiraea* spp. Distr.: Northeastern and northwestern North America. Russo 2021, Eiseman 2025a.

Clinodiplosis spiraeina. Larvae of this inquiline have been found in spent galls of the above species as well as in those of "*Cecidomyia*" *lappa* above. Host: *S. alba*. Distr.: New England.

4b Single leafy rosette, Plate 87 (8), see Image 98 ..... cecidomyiid and *Contarinia spiraeina* Felt

Cecidomyiid. Galls are monothalamous. Larvae drop to the soil in fall. Adults have not been reared, but the larvae causing the gall do not belong to *Contarinia*. This gall is possibly a further development of a bracteate gall with much looser outer bracts. Host: *S. douglasii*. Distr.: Washington, Oregon.

C. spiraeina. The single series of this species was reared in spring from pale orange or white gregarious larvae found in a terminal, "cabbage" or "lettuce" gall (Felt 11911, 2018b), although Felt later attributed the species to a bud gall about 3 mm in diameter (Felt 1921). Host: *S. alba*. Distr.: Massachusetts.

5a Swollen stem ..... *Neolasioptera* sp.

This species is known from a single larva in the Felt collection. Host: *Spiraea* sp. Distr.: New York.

5b Leaf gall 6
6a Swollen midrib or leaf margin 7
6b Circular spot or blister gall becoming conical 8
7a Swollen, podlike midrib, Plate 87 (4-5), see Image 99 ..... *Dasineura salicifoliae* (Osten Sacken)

D. salicifoliae. Galls are prominent, especially seen from the lower leaf surface, podlike, hard, usually red, single-chambered swellings with one to usually several gregarious, orange larvae. Fully grown larvae exit through a slitlike opening that develops along the upper side

of the midrib. Hosts: *S. alba*, *S, douglasii*, *S. splendens*, *S. tomentosa*. Distr.: New England to Ontario and British Columbia to Oregon. Russo 2021, Eiseman 2025a.

7b Marginal leaf roll, Plate 87 (7) …… *Dasineura* sp. and *Clinodiplosis spirae* Felt

Dasineura sp. The gall is a hard, tight, rolled leaf margin that simulates a crescent roll. This unnamed species is presumably responsible for the gall. Host: *S. alba*. Distr.: Massachusetts, Ontario.

C. spirae. Felt (1921) attributed the gall to this species, but I have found only *Dasineura* larvae in marginal leaf rolls. Additionally, a larva of *Dasineura* was associated with the adult type specimen of *C. spirae*. Host: *S. alba*. Distr.: Maine, Massachusetts.

8a Blister or conical leaf gall, Plate 87 (9) …… cecidomyiid

The gall begins as a blister but eventually becomes more or less conical. Galls were collected in May. Only the larval stage of this gall maker is known. It cannot be placed to genus. Host: *S. alba*. Distr.: New England and New York.

8b Circular, flat leaf spot, Plate 87 (10) …… *Dasineura* sp. and *Lasioptera spiraeafolia* Felt

Dasineura sp. This undescribed species is the one usually found in the leaves as larvae and subsequently reared as adults. Spots are about 3-4 mm in diameter, the upper surface discolored, the center brown to black, the border yellow, the undersurface pale yellow. The single larva in each spot is usually visible through the epidermis. Full-grown larvae leave the galls to pupate. The species is probably multivoltine. Hosts: *S. alba*, *S. douglasii*, *S. splendens*. Distr.: Maine to New York, Maryland and Washington.

L. spiraeafolia. The larva associated with Felt's holotype of this species is a *Dasineura*, as are other larvae from this gall that I have seen from Maine and Washington. This species may have been an inquiline or a contaminant in the rearing container,

Rubiaceae

Cephalanthus (buttonbush)

Swollen stem …… …… …… *"Rabdophaga" cephalanthi* (Felt)

Adults were reared in spring from twigs collected the previous fall. This species is unplaced to genus. Host: *C. occidentalis*. Distr.: New York.

Galium (bedstraw)

1a Fusiform stem swelling …… *Neolasioptera* sp.

Galls were collected in October and adults emerged in March of the following year. Host: *G. circaezans.* Distr.: Oklahoma, North Carolina. See on iNaturalist.

1b Swollen, unopened, aborted flower 2
2a From eastern North America ..... *Dasineura americana* Felt and *Contarinia* sp.

D. americana. Adults were reared in late summer from yellowish larvae. Hosts: *G. asprellum.* Distr.: Massachusetts, Rhode Island and North Carolina. Eiseman 2025a.

Contarinia sp. This undescribed species was reared from larvae from the same kind of gall. Host: *G. asprellum*. Distr.: New York.

2b From California, see Image 100..... *Resseliella* sp.

Galls with orange larvae with pebbled integument were collected in mid-April. Host: *G. maritimum*. Distr.: California.

Psychotria (wild coffee)

Swollen stem and leaf ..... cecidomyiid

The gall maker is known only from pupal exuviae found protruding from the galls. Swellings of the stems were 10 mm long and 8 mm at the widest point. Host: *Psychotria* sp. Distr.: Florida.

Spermacoce (false buttonweed)

Clustered, spheroid flower bud galls, see Image 101 .... *Asphondylia* sp. possibly *borreriae* Rübsaamen

Galls grow in a cluster, each about 5 mm diameter, the central chamber lined with a white fungus. The gall tissue is large-celled, soft and spongy. Adults emerge in August and October so at least two generations appear per year. Similar galls on *Spermacoce verticillata* in Brazil are caused by *Asphondylia borreriae* Rübsaamen. Hosts: *S. neoterminalis*. Distr.: Florida; possibly also Brazil.

Rutaceae

Citrus (citrus)

Larva in flower ..... *Prodiplosis longifila* Gagné

Larvae of this polyphagous species are gregarious and occur in large numbers on the surfaces of the ovary, pistils and stamens of individual flowers of citrus, causing the fruit to abort. Mature larvae drop to the ground and burrow into the soil, mostly at a depth of about 1.5 cm

where they spin white cocoons, often incorporating sand grains. Hosts: *Citrus* sp. (Tahiti lime); also wild cotton in Florida and various crop plants in Colombia and Peru, including alfalfa, castorbean, green beans, potato and tomato. Distr.: Florida; Jamaica and Colombia to Peru. Peña et al. 1989, Gagné 1994.

Zanthoxylum (prickly ash)

Stem swelling just above the soil …… *Neolasioptera* sp.

Host: *Zanthoxylum* sp. Distr.: Iowa.

Salicaceae

Populus (aspen, cottonwood, poplar)

Nearly all gall midges on *Populus* belong in the genus *Harmandiola*. Their galls are usually monothalamous, yellow, green, or red outgrowths of the leaf lamina or petiole. Full-grown larvae drop to the ground in late spring or summer through an orifice to one side of the petiole or leaf and overwinter in the soil. Each of the ten *Harmandiola* species keyed only to generic level here is presumed to be a distinct species. Some of the *Harmandiola* galls resemble illustrations for various European species in Rübsaamen & Hedicke (1926-1939, Pl. XXXVII). The Nearctic fauna may be partly conspecific with that of the Palearctic. One should also be aware that many poplar galls are caused by aphids of the genus *Pemphigus* (Hemiptera: Aphididae) Exteriorly these can superficially resemble galls made by *Harmandiola*, but their inhabitants have legs and are surrounded by a waxy substance. For a pictorial key to those aphids see Gallformers.org.

A photographic key by Roslin (2003) of cecidomyiid galls on *Populus tremuloides* in Alberta is the source of many of the *Harmandiola* photographs that are used here, with his kind permission. That citation is not repeated below because the paper is no longer supported on the web. See Roslin and Roland (2005) for fuller context on poplar gall ecology.

1a Swollen winter buds or twigs …… 2
1b Leaf galls …… 4
2a Enlarged winter bud, Plate 88 (2) …… *Dasineura* sp. and *Rabdophaga populi* Felt

Dasineura sp. Infested buds are 1.0-2.5 cm long by about 1 cm or more in width, made up of overlapping bracts, the interstices covered with a yellow, sticky exudate. Galls begin to form in May. Several larvae live freely among the bracts, are first red and turn white as they mature. In autumn larvae form cocoons on or among the bud scales where they diapause and develop into pupae in spring. Infested buds are killed. Host: *P. balsamifera*. Distr.: Washington, Oregon and Minnesota. Larew and Capizzi 1983.

R. populi Felt is known only from specimens reared in spring from cocoons at the base of buds. The damage they are associated with remains unknown. Host: *P. tremuloides*. Distr.: New York.

2b Twig swellings 3
3a Woody twig swelling, Plate 89 (1) ..... *Contarinia* sp.

The red, gregarious larvae tunnel inside the fresh twigs. Affected branches are usually killed. Host: *P. tremuloides*. Distr.: Alaska, British Columbia, Alberta, Montana, Wyoming.

3b Soft beadlike or carinate swelling causing stem to twist, Plate 89 (2) ..... *Contarinia* sp.

Larvae are white, semi-gregarious, one or more within each tunnel just under the epidermis below the carinate ridges on stems. Host: *P. tremuloides*. Distr.: Washington. Russo 2021.

4a Simple circular leaf spot, may be slightly convex on upper leaf surface 5
4b Curled leaf edge or prominent swellings of petiole or leaf lamina 6
5a Larva free in shallow concavity on underside of leaf, Plate 89 (3-4) ... *Leucecis eminens* Gagné

Each concavity harbors a single white larva covered with a sticky fluid. A light-colored area about 5.5 mm diam. surrounds the point of feeding. The affected region on the upper side of the leaf is marked by a short cone at its center. Larval development takes about two weeks and two or more generations occur per season. The full-grown larvae, by then turned orange, drop to the soil and spin a cocoon. The spots turn necrotic after the larvae exit. Hosts: *P. balsamifera*, *P. trichocarpa*. Distr.: Alaska to California, Alberta, Montana, Minnesota. Whitney and Baranyay 1968, Gagné et al. 2026. See on iNaturalist.

5b Larva inside lamina under a flat, circular, slight blister, Plate 88 (3a) ..... *Contarinia* sp.

Hosts: *P. balsamifera*, *P. deltoides*, *P. tremuloides*, *P. trichocarpa*. Distr.: Alaska, Ontario, New York, Mississippi.

6a Curled leaf or leaf margin, Plate 88 (1) ..... *Prodiplosis morrisi* Gagné

Eggs are laid in newly developing leaf buds. Larvae are gregarious within the marginal bract curls. Full-grown larvae drop to the ground to pupate. Up to five generations occur per year in Ontario. Infested leaves become deformed and later turn brown. Severe damage can stunt terminal leaders. Hosts: *P. deltoides*, *P. tremuloides* and hybrid poplars. Distr.: eastern North America, Kansas, Texas and California. Morris 1981, Russo 2021.

6b Globular or spindleform galls on petiole or leaf lamina 7
7a Galls on petiole 8
7a Galls on leaf lamina 9
8a Galls spheroid to conical, succulent, tapering to orifice, Plate 89 (5) ..... *Harmandiola* sp.
.

Host. *P. tremuloides*. Distr.: Washington.

8b Gall elongate, keel-like, hard, orifice extending along length, Plate 89 (6) ..... *Harmandiola* sp.

Host. *P. tremuloides*. Distr.: Alberta.

9a Spindleform, elongate leaf fold or leaf-edge swelling 10
9b Spheroid galls 11
10a Elongate swelling along lamina, Plate 90 (3-4) ..... *Harmandiola* sp.

The gall is more prominent on the underside of the leaf. The long slitlike orifice appears on the upper side of the leaf (5). Host. *P. tremuloides*. Distr.: Alberta.

10b Leaf-edge swelling, Plate 90 (5) ..... *Harmandiola* sp.

Galls are spindleform, thick-walled and brittle. Host. *P. tremuloides*. Distr.: Alberta.

11a Galls closely adjacent or fused, usually situated at junction of lamina and petiole but may extend along midrib, Plate 90 (1-2) ..... *Harmandiola* sp.

Individual galls are conical, slightly lobed, protruding on both sides of leaf and opening on underside. The lips of the orifice are uneven. Generally similar galls to those from Alberta, but from New York, were attributed to a *Mycodiplosis coniophaga* (Winnertz) (as *M. populifolia* Felt), but that species is mycophagous and presumably a contaminant. *Rhizomyia absobrina* (Felt) was also reared from such galls in New York, but it is also mycophagous. Hosts: *P. tremuloides*, *Populus* spp. Distr.: Alberta, New York, Maine.

11b Galls not adjacent to petiole, discrete 12
12a Galls protruding from both sides of leaf 13
12b Galls protruding only on upper side of leaf 15
13a Galls conical on underside of leaf, hemispherical above, Plate 90 (6) ..... *Harmandiola* sp.

Host. *P. tremuloides*. Distr.: Alberta.

13b Galls hemispheroid on both leaf surfaces 14
14a Galls adjacent to a leaf vein, evenly protruding from both leaf surfaces, orifice a concavity on underside, Plates 88 (3b), 92 (3-4) ..... *Harmandiola stebbinsae* Gagné and *Harmandiola helena* (Felt)

H. stebbinsae. Gagné (1989) misapplied this species to a gall now attributed to *Leucecis eminens* Gagné. A subsequent study of Stebbins's type galls shows that they fit the galls attributed to *H. helena*. The two species may be synonyms. Host *P. grandidentata*. Distr.: Alberta, New York, Massachusetts. Russo 2021.

H. helena. Host: *P. tremuloides*. Distr.: Massachusetts.

14b Galls on lamina, mostly protruding from lower leaf surface, the upper surface simulating two lips surrounding the orifice, Plate 92 (1-2) ..... *Harmandiola* sp.

Host. *P. tremuloides*. Distr.: Alberta.

15a Galls ovate, narrowly attached to leaf, wall thick, fleshy, Plate 91 (1-2) …… *Harmandiola* sp.

This gall resembles that of the European *Harmandiola tremulae* (Winnertz) but, as with that of the species in the alternate half-couplet, the identification has not yet been authoritatively established. Host. *P. tremuloides*. Distr.: Alberta.

15b Galls broadly attached to leaf, wall thin and brittle, Plate 91 (3-4) …… *Harmandiola* sp.

Roslin (2003) listed this gall as that of the European *Harmandiola globuli* (Rübsaamen), but adults of the gall makers from the two localities have not been authoritatively compared. Host. *P. grandidentata, P. tremuloides*, *Populus* sp. Distr.: Alberta, possibly New York.

Salix (willow)

Willow galls are diverse, but very little of a comprehensive nature has been done on the gall midges responsible, especially in North America. Particular galls are commonly found from coast to coast on many willow species, Except for *Rabdophaga rigidae* (Osten Sacken) no survey anywhere in the Holarctic has been made to determine whether one or more species are responsible for a particular kind of gall over such a large expanse and number of possible hosts. For instance, galls similar to those of *Rabdophaga strobiloides* (Osten Sacken), a species originally described from Illinois on *Salix cordata* (see Plate 93 (1-2)), were discovered in Arizona on two separate species of willow, *Salix lutea* and *Salix exigua* (DeClerck-Floate & Price 1994). Each of those two plants yielded a distinct species of *Rabdophaga*, both different from *R. strobiloides*. For that reason, *Rabdophaga* species are treated very narrowly in this key, many of them according to their original descriptions by Walsh (1864). Many of the illustrations on Plate 93 are based on Walsh's original collection that now resides in the USNM.

The niche of many species is either not exactly known or, at best, insufficiently described to include in the key. Their type series are available, so a thorough revision may eventually sort them out. These species are: *Rabdophaga essigi* Felt from apparently normal buds in California; *Rabdophaga globosa* Felt from twigs bearing small rounded galls in New York; *Rabdophaga latebrosa* Felt from apparently normal willow buds in New York; *Rabdophaga latipennis* Felt from an inconspicuous, knotted gall in Illinois; *Rabdophaga normaniana* Felt from a small apical gall in Manitoba; *Rabdophaga persimilis* Felt from either a typical though slender gall of *Rabdophaga strobiloides* or an unrecognized twig gall in New York (Felt 1915a); *Rabdophaga racemi* Felt from small, clustered galls arising from buds in Manitoba; *Rabdophaga tumidosae* (Felt) from a subglobular gall in Illinois; *Rabdophaga walshii* (Felt) from a spongy or clustered gall in Illinois; and *Asphondylia salictaria* Felt, reportedly from willow twigs in Indiana. The last item appears to have been mislabeled in Felt's laboratory during the slide-mounting process. It was among pinned specimens sent to Felt for his interest by USDA staff at the USNM in Washington, DC. The USDA code number, 4423 in this case, was copied to the *A. salictaria* slide label, but the number in the USDA card file at the USNM refers not to a specimen from Indiana but to insects taken from willow stem swellings in the Washington DC area. Descriptive notes in the card file refer to a Rabdophaga-like gall midge (e.g., the antenna had 22 segments). Interestingly also, no other *Asphondylia* has ever been recorded from willow anywhere in the world.

Finally, a group of species referred to *Iteomyia* on various willow species are also treated conservatively here. These form a variety of yellow, red or otherwise brightly colored leaf galls that are variously pointed or tubelike on the underside of leaves and blisterlike on the upper side. Two species from such galls have been described and are keyed here, but many more evidently occur. See Russo (2021) for several additional examples of galls on various species of willow from western North America. *Iteomyia* will also require comprehensive study to resolve.

1a Bud gall 2
1b Swollen twigs or leaf galls, including simple leaf clusters 9
2a Bud gall comprising many modified, overlapping leaves 3

Infested twigs are foreshortened, stunted stems with reduced potential for future growth (DeClerck-Floate & Price 1994). Leaves of these galls are typically largest on the outside of the gall and narrow considerably toward the center. The gall formers are always at the heart of the gall, surrounded by linear leaves. The larva feeds upside down and reverses position before pupation. These species have one generation per year. Larvae are full-grown in fall and overwinter in the gall in a cocoon where they pupate the following spring.

2b Bud enlarged or elongated, not comprising modified leaves 8
3a Modified leaves generally appressed, imbricate, simulating a pine cone 4
3b Modified leaves loose, exfoliate, forming an open rosette 6
4a Leaves wider than long, apex of gall attenuate, closed; twig beneath the gall straight, Plate 93 (1-2) ..... *Rabdophaga strobiloides* (Osten Sacken) and inquilines

R. strobiloides. This species is the gall maker and is found singly in a chamber at the very center of the gall. Host: *S. cordata* and possibly other *Salix* spp. in Illinois. Distr.: Illinois, probably elsewhere. Walsh 1864, Wilson 1968c, Weis 1984, Weis & Kapelinski 1984.

Dasineura albovittata (Walsh). Red larvae of this species are commonly found in large numbers among the gall's leaf scales. Adults are much smaller than the gall former and their legs have alternating light and dark bands. At least two generations occur each year, one in spring when the gall forms and another in summer that eventually overwinters in cocoons between modified leaves of the gall. Hosts: *Salix* spp. Distr.: Illinois to Massachusetts and Maryland.

Dasineura gemmae Felt. This was reared from diminutive forms of galls reportedly produced by *R. strobiloides*. Host: *Salix* sp. Distr.: Utah.

4b Leaves triangular, narrowing toward tip to produce an open ``beak," or twig recurved below gall 5
5a Tip of gall beaklike; twig beneath gall not recurved .... *Rabdophaga salicisstrobiliscus* (Osten Sacken)

The original report of this gall (Walsh 1864) suggested that it might only be an aberrant form of that formed by *R. strobiloides*. Hosts: *S. discolor, S. rostrata*. Distr.: Illinois. Walsh 1864.

5b Tip of gall not beaklike; twig beneath gall recurved, Plate 93 (3) .... *Rabdophaga salicisgnaphaloides* (Osten Sacken)

Galls are smaller than those of *R. strobiloides*, only about 5-10 mm long and 5 mm wide. Hosts: *S. candida, S. humilis*. Distr.: Illinois. Walsh 1864.

6a Leaves conspicuously longer than wide, Plate 93 (4) .... *Rabdophaga salicisbrassicoides* (Packard) and inquilines

R. salicisbrassicoides. Galls range from 5-25 mm diam., the dimensions evidently dependent on the size of the affected twig. Host: *S. exigua*. Distr.: Illinois. Walsh 1864.

Lestodiplosis septemmaculata (Walsh) is a predator. It was presumably feeding on a cecidomyiid or other arthropod living among the leaves making up the gall. Host: *Salix* sp. Distr.: Illinois.

"Cecidomyia" frater Cockerell was described from galls ascribed to *R. salicisbrassicoides* but the type male is lost. The description was accompanied by a sketchy drawing of a male gonostylus so it is possible the species can be identified someday. This species is listed with unplaced Cecidomyiinae in Gagné and Jaschhof (2025). Host: *Salix* sp. Distr.: Colorado.

6b Leaves almost as wide as long 7

7a Gall leaves open, flared, the gall shorter than wide, Plate 93 (8) .... *Rabdophaga saliciscoryloides* (Osten Sacken)

Galls are 5-7 cm long and 5-10 cm in diameter. The apparent difference between these and galls of *R. salicisbrassicoides* and *R. salicisrhodoides* is not great. Host: *Salix* sp., possibly *discolor*. Distr.: Illinois. Walsh 1864.

7b Gall leaves more sessile, the gall longer than wide, Plate 93 (6) .... *Rabdophaga salicisrhodoides* (Osten Sacken)

The gall simulates an elongated rose blossom. It is 1-2 cm diam. and 2-5 cm long. Host: *S. humilis*. Distr.: Illinois. Walsh 1864.

8a Lateral bud modified into an elongate, thin-walled, hornlike structure, Plate 93 (7) .... *Rabdophaga saliciscornu* (Osten Sacken)

Galls are slender, cylindrical, monothalamous, 10-20 mm long, about 2 mm wide, pointed at the tip and slightly curved. Host: *S. humilis*. Distr.: Illinois. Walsh 1864.

8b Terminal, ovate, woody, foreshortened bud with abruptly pointed apex, Plate 93 (9) .... *Rabdophaga rigidae* (Osten Sacken) and inquiline

Galls are monothalamous, subglobular to tapered, 1-3 cm long and 0.5-1.0 cm wide. The galls are first evident in May. A few leaves often begin to grow beyond the gall but soon die.

After the adults emerge from the galls the following spring, the buds usually die, but new stem growth may develop from around the base of the gall. Adults are variable in size depending on the host species or variety (Smith et al. 1983). Hosts: *Salix humilis* and many other spp. Distr.: widespread North America; eastern Asia, including Japan. Wilson 1968b, Nijveldt and Yukawa 1982, Smith et al. 1983.

Dasineura sodalidatis (Felt). This species was reared from what appeared to be a gall of *R. rigidae*. Host: *Salix* sp. Distr.: New York.

9a Swollen twig 10
9b Leaf gall 12
10a Foreshortened, swollen twig, the buds close together, Plate 93 (5) .... *Rabdophaga salicistriticoides* (Osten Sacken)

Buds may be so close as to resemble kernels on a wheat head, thus the name. The enlargement is 2-4 cm long. Larvae overwinter in the galls and adult emergence takes place in spring. Host: *S. cordata*. Distr.: New York and Illinois. Walsh 1864.

10b Internodal twig swelling without foreshortening of the stem 11
11a Twig swelling very large, soft, sometimes resembling a potato in shape, Plate 94 (3) .... *Rabdophaga salicisbatatas* (Osten Sacken) and *Rabdophaga ramuscula* Felt

R. salicisbatatas. This gall is variable in shape, usually polythalamous and bulges abruptly out of the twig. One generation occurs per year. Adults emerge from the galls in spring. Hosts: *S. humilis* and *Salix* spp. Distr.: New England to California. Walsh 1864.

R. ramuscula. The gall attributed to this species was reportedly identical to that of *R. batatas*, but the two gall midge species are distinct. Host: *Salix* sp. Distr.: New York.

11b Twig swellings, woody, variously swollen but sometimes barely noticeable, Plate 94 (4) .... *Dasineura corticis* Felt, *Lygocecis* spp., *Neolasioptera* sp. and *Rabdophaga* spp.

D. corticis. This species was reared in May from small cavities beneath bark. It may be an inquiline or a secondary feeder. Host: *Salix* sp. Distr.: Massachusetts.

Lygocecis packardi (Felt) was reared from enlarged willow stems. Females of this and the following species have a sawlike ovipositor evidently used to insert their eggs into willow shoots. Larvae have a greatly enlarged spatula. Host: *S. exigua*, *Salix* spp. Distr.: Massachusetts to Texas.

Lygocecis porterae (Cockerell) was reared from a slight, smooth twig swelling. Host. *Salix* sp. Distr.: New Mexico.

Neolasioptera sp. This item was reared in May from stem galls made by a sawfly (Hymenoptera: Tenthredididae: *Euura* sp. *(*as *Pontania* sp.)) following emergence of the sawflies. The gall midge is possibly an inquiline or a contaminant in a rearing jar. This is the

only record of a *Neolasioptera* on willow. Host: *S. humilis*. Distr.: Ontario.

Rabdophaga cornuta (Walsh). Walsh (1864) found this species in cylindrical tunnels in stems widened due to the presence of *R. salicisbrassicoides* galls. Host: *S. exigua*. Distr.: Illinois.

Rabdophaga salicis (Schrank). This species causes subglobular or spindleform twig galls and occurs on many willows in both Europe and Japan. Specimens identified as this species in North America were found on imported nursery stock. They could well belong to a different European species. American specimens identified in the past as *R. salicis* do not compare exactly with European or Asian specimens identified as that species. Nijveldt and Yukawa 1982.

Rabdophaga salicisnodulus (Osten Sacken). This species was originally reared from small, woody, monothalamous galls, but similar galls are often polythalamous, some harboring more than one species. Heavily infested shoots can be killed. The exit holes seen in spring are ultimately cut by the pupae. This and the other *Rabdophaga* and *Lygocecis* species listed in this couplet may have only one generation per year. Host: *Salix* spp. Distr.: Illinois to New England. Walsh 1864, Wilson 1968a.

Rabdophaga spp. Several species needing revision were reared from slight swellings of willow twigs and are placed together here, all except the last from undetermined species of *Salix*: *Rabdophaga americana* (Felt) from elongate, slender swelling in Illinois; *Rabdophaga caulicola* (Felt) from slender twigs in Illinois; *Rabdophaga caudicis* Gagné from slender twigs in Illinois; *Rabdophaga occidua* Gagné from branches in California; *Rabdophaga perocculta* (Cockerell) from stems in Colorado; *Rabdophaga podagrae* Felt from long, inconspicuous twig swellings in New York; and *Rabdophaga timberlakei* (Felt) from branches with hardly any swellings on *Salix lucida* (as *fendleriana*) in California. A proper revision of *Rabdophaga* species from willow twigs may find that some of the names above are synonyms of *R. cornuta* or *R. salicisnodulus*.

12a Circular, nearly flat leaf spot …… cecidomyiid

Spots are slightly less than 1 cm in diameter. A single larva lives and pupates inside the lamina. In late August pupal exuviae were found partly exserted from the center of the spots, so the species presumably has more than one generation per year. Host: *S. hookeriana*. Distr.: Oregon. See on iNaturalist.

12b Basal leaf swelling, rolled leaves, or complex galls …… 13
13a Basal leaf swelling …… …… cecidomyiid

The yellow to pink swellings are about 1 cm long and contain several yellow larvae in individual chambers. Larvae appeared full-grown in late August. Host: *S. hookeriana*. Distr.: Oregon. See on iNaturalist.

13b Complex spheroid, conical or cylindrical leaf galls …… 14

14a Tightly rolled individual leaf or cluster of several adherent terminal leaves 15
14b Complex spheroid, conical or cylindrical leaf galls 16
15a Tightly rolled individual leaf, Plate 94 (2) ..... *Dasineura plicata* (Felt)

Leaves are tightly rolled into a tube. Full-grown larvae form cocoons in the leaves. Adults were reared in May and August. Host: *Salix* sp. Distr. New York and Massachusetts.

15b Cluster of young, terminal, adherent leaves ..... *Dasineura salicifolia* Felt

Larvae were found crawling among leaves in the cluster. Host: *Salix* sp. Distr. New York and Massachusetts.

16a Galls spheroid, protruding from one side of leaf, Plate 94 (1b) ..... *Iteomyia salicifolia* (Felt)

Galls are monothalamous and about 2 mm in diameter. Full-grown larvae drop to the soil in late summer and spin cocoons in which they overwinter. Host: *Salix* sp. Distr.: Washington, New York.

16b Galls cylindrical, narrowed apically, Plate 94 (1a) ..... *Iteomyia salicisverruca* (Osten Sacken)

Galls are monothalamous, 2-3 mm in diameter and often coalesced. Larvae presumably leave the galls in the fall, as do larvae of *I. salicifolia*. Host: *S. humilis* and *Salix* spp. Distr.: New York, Illinois, Washington and Oregon. Walsh 1864.

Sapindaceae

Acer (maple)

Gall midges of simple-leaved maples are distinctly different from those on the compound-leaved *Acer negundo*.

1a Galls on simple-leaved maples 2
1b Galls on compound-leaved maple (box-elder) 9
2a Circular, usually red leaf spot with exposed larva on underside of leaf, Plate 24 (3b) .....
..... *Acericecis ocellaris* (Osten Sacken)

Spots are about 5 mm in diameter, usually red, but sometimes light green or yellow and evident in spring as soon as leaves are fully expanded. Some new spots may develop in small numbers in early summer. Larvae, one on the underside of each spot, are stationary in a sticky substance and feed only at the slightly concave central point to which their mandibles are attached. When fully grown, still in spring, the larvae drop to the soil, where they diapause within brown cocoons. Leaf spots turn brown after the larvae have dropped to the soil, but damage to the leaves appears to be slight. Hosts: chiefly *A. rubrum* on which galls are usually most common; also *A. circinatum*, *A. pensylvanicum*, *A. saccharinum*, *A. saccharum*, *A. spicatum*. Distr.: widespread, wherever maples occur in North America. Gagné 1983b.

2b Pouch, fold, or other distortion of leaf; the larva fully covered by leaf tissue 3
3a Broadly folded, distorted leaves 4
3b Discrete, regular, marginal or vein folds 5
4a Crinkled leaf of silver maple, *Acer saccharinum*, Plate 24 (2) .... *Dasineura aceris* (Shimer) and *Dasineura rileyana* (Felt)

These two species, reared from similar galls, may be synonymous. Adults are unknown for D. aceris, but it is the older name and the one to use until the taxonomy is resolved. Damage usually occurs on expanding leaves, which become distorted and crumpled. Young leaves are often killed. When the gregarious larvae are full-grown, they form a webbing over the folds and pupate there. Several overlapping generations may occur over the summer. Host: *A. saccharinum*. Distr.: Ontario to Wisconsin, south to Maryland and Kansas. Watson 1973.

4b Crinkled leaf on other maples, as for Plate 24 (2) ..... *Dasineura communis* Felt

The damage to at least red maple, *A. rubrum*, is attributed to *D. communis*; it is not definitely known if similar galls on other maples are caused by this gall midge. Hosts: *A. circinatum*, *A. rubrum*, *A. pensylvanicum*, *A. saccharum*. Distr.: widespread North America.

5a Leaf fold along margin, Plate 24 (3c) ..... *Contarinia* sp. and *Dasineura* sp.

One or two larvae of either genus, but usually of *Contarinia*, are found in these bright yellow and red folds that are visible in early spring as soon as the leaves have fully expanded. Larvae develop quickly and drop to the soil to diapause. Adults have not been reared. Host: *A. rubrum, A, saccharum*. Distr.: Connecticut and New York to Maryland.

5b Vein pouch or fold, more prominent on underside of leaf 6
6a Short, bilobed swelling limited to vein fork with short, median extension onto lamina; larvae exit from underside of leaf, Plate 24 (3d) ..... *Dasineura* sp.

Galls are visible only from the underside of the leaf. They appear in spring and each contains one, sometimes two larvae. By mid-May in Maryland larvae are fully grown and drop to the soil where they remain until the following spring. Host: *A. saccharum*. Distr.: Connecticut to West Virgina and Maryland, probably wherever the host occurs.

6b Longitudinal swelling along vein; larvae exit from upper side of leaf 7
7a Swelling 1 to several cm long; larvae gregarious, usually several in each, exiting in early spring, Plate 24 (3a) ..... *Dasineura* sp.

Galls are more or less fleshy, 3-15 mm long and most conspicuous on the underside of fresh leaves. The numerous larvae in each exit in spring. Adults from these galls are unknown. Hosts: *A. rubrum*, *A. saccharum*, perhaps other spp. Distr.: eastern North America.

7b Swelling a short pouch, rarely more than 4 mm long; usually a single larva in each, occasionally 2, exiting at end of summer 8

8a Pouch glabrous with sparse hair, nearly as high as long, green; turning brown, appearance on upper leaf surface bulbous, resembling a pair of lips, see Image 102 …… *Dasineura* sp.

Galls are usually green, sometimes red or tan. Larvae rapidly become second instars in April/May and remain in that state until mid to end September when they change into the third and last instar. The gall opens shortly after on the upper side of the leaf, allowing the larva to drop to the soil. Host: *A. saccharum*. Distr.: Connecticut to West Virgina and Maryland, probably wherever the host occurs.

8b Pouch corrugated, without hair, longer than high, usually yellow; appearance on upper leaf surface a simple scar, see Image 103 …… *Dasineura* sp.

Galls are usually yellow, but may be green or red. Larvae rapidly become second instars in April/May and remain in that state until mid to end of September when they turn into the third and last instar. The gall then opens on the upper side of the leaf, allowing the larva to drop to the soil. Host: *A. saccharum*. Distr.: Connecticut to West Virgina and Maryland, probably wherever the host occurs.

9a Rough, irregular twig swelling …… cecidomyiid

The swelling is reportedly 2-4 cm long (Felt 1940, 1965). Host: *A. negundo*. Distr.: unspecified.

9b Bud or leaf galls …… 10

10a Globular pouch gall along veins, Plate 24 (1c) … …… *Contarinia* sp.

These reddish, inconspicuous galls appear in June on the upper side of fully expanded leaflets and result from an inpocketing of the leaflet. Each gall contains a single larva. Adults have not been reared. Host: *A. negundo*. Distr.: Maryland.

10b Swollen, succulent leaflet or leaf bud, Plate 24 (1a,b) …… *Contarinia negundinis* (Gillette)

Galls appear in early spring when leaves are expanding. The feeding site of the larvae on the leaflets or, less commonly, in the bud at the base of developing petioles evidently depends on the tissue available when females lay their eggs. The numerous white larvae within a swelling are gregarious. Occasionally, thicker swollen galls may be secondarily partitioned. Larvae develop quickly and drop to the ground where they spin a cocoon. Unlike most gall midges that overwinter in the ground as larvae, *C. negundinis* diapauses in the pupal stage. Maggots of *Megaselia submarginalis* (Malloch) (Diptera; Phoridae) can sometimes be found preying on the larvae inside the galls. Host: *A. negundo*. Distr.: eastern North America with incursions to the west, including Saskatchewan. Wilson 1966, Robinson & Brown 1993.

Aesculus (buckeye)

Tightly rolled leaflets …… *Contarinia* sp.

Hosts: *A. glabra*, *A. pavia*. Distr.: Maryland, Florida.

Sapotaceae

Bumelia (see *Sideroxylon*)

Sideroxylon (bully)

1a Irregular twig swelling, Plate 94 (7) ..... *Bruggmanniella bumeliae (*Felt*)*

Swellings are 2-5 cm long and polythalamous. Each larva lives in a separate chamber in the cambium layer. Galls are present throughout the year. Adults of the type series from Texas emerged from the galls in May. Hosts: *S. lanuginosum, S. reclinatum*. Distr.: South Carolina, Florida, Louisiana, Texas, Oklahoma and New Mexico. Gagné 1994.

1b Leaf galls 2
2a Rolled leaf ..... *Contarinia* sp.

Leaves are rolled along the longitudinal axis, are slightly swollen and often reddish. Larvae inside the roll are gregarious and drop to the soil when full-grown. Host: *S. lanuginosum*. Distr.: Florida.

2b Hemispherical to conical laminar galls, see Image 104 ..... cecidomyiid

Galls show on both leaf surfaces but are tapered on the underside. Host: *S. celastrinum*. Distr.: Florida.

Sarcobataceae

Sarcobatus (greasewood)

1a Swollen bud, Plate 25 (6) ..... *Onodiplosis sarcobati* Felt

Enlarged buds are about 10 mm long and 6 mm in diameter and made up of thickened, appressed bud scales. Pupation occurs inside the buds and adults emerge in spring. Host: *S. vermiculatus*. Distr.: Idaho and Utah. Dorchin et al. 2021.

1b Swollen leaf or stem 2
2a Swollen, discolored leaf, Plate 25 (6a) ..... *Protaplonyx sarcobati* (Felt)

Adults were reared in both spring and summer, so this species has at least two generations per year. Females have a hard, sword-shaped ovipositor presumably used in piercing plant tissue. Host: *S. vermiculatus*. Distr.: Colorado and Utah. Gagné 1969b.

2b Swollen stem, Plate 25 (6b) ..... *Neolasioptera* sp.

Adults of this species have not been reared. Host: *Sarcobatus* sp. Distr.: Oregon and Utah.

Saxifragaceae

Heuchera (alumroot)

In swollen flowers …… *Contarinia* sp. and cecidomyiid

Contarinia sp. Gregarious, white larvae can be found in abnormally swollen flowers. Fully fed larvae drop to the soil to pupate. There may be only one generation year. Host: *H. richardsonii*. Distr.: Minnesota.

Cecidomyiid. Robust, orange adults of this unidentified gall midge emerged from flowers as a thunderstorm threatened. Host: *H. richardsonii*. Distr.: Iowa.

Mitella (bishop's cap)

Larva in stem internode, its presence inconspicuous …… *Neolasioptera* sp.
Larvae live singly or end to end inside internodes, which may turn black when larvae are mature. Full-grown larvae form a silken cocoon in their galleries in which they overwinter. Host: *M. diphylla*. Distr.: Iowa. See on BugGuide.

Scrophulariaceae

Buddleja (butterfly bush)

Enlarged flower bud …… *Asphondylia buddleia* Felt

Aborted flower buds are about twice normal size and the corolla fails to open. A single larva occurs in each affected flower. Adults were reared in summer. Host: *B. racemosa*. Distr.: Texas; El Salvador. Painter 1935, Möhn 1960a.

Leucophyllum (barometer bush)

Larva on leaf …… *Contarinia* sp.

Larvae of this unidentified species were intercepted with their host at the United States-Mexico border. Host: *L. frutescens*. Distr.: Mexico (unspecified).

Scrophularia (figwort)

1a Distorted flower bud …… *Contarinia* sp.

A *Contarinia* larva collected in July was initially associated with the deformity and presumably caused the damage. The predaceous *Lestodiplosis scrophulariae* (Felt) was also taken from the buds. Host: *S. marilandica*. Distr.: New York.

1b Swollen stem or barely swollen petiole base ……2
2a Swollen stem …… *Neolasioptera* sp.

Galls are woody, fusiform swellings about 1 cm long and noticeably wider than normal stems. They occur just under a node on main or lateral stems. In spring each gall contains one or two orange larvae covered in black fungal excrescence that fills the rest of the enclosure. An exit tunnel pointing upwards in the stem opens to the base of a previous year's leaf. Host: *Scrophularia* sp. Distr.: Iowa.

2b Barely swollen petiole base …… *Neolasioptera* sp.

The swelling is barely noticeable and bears a single larva filling the pith. The gall may only be a separate manifestation of the swollen stem gall. Host: *Scrophularia* sp. Distr.: Iowa. See on BugGuide.

Simmondsiaceae

Simmondsia (jojoba)

Deformed, aborted fruit …… *Asphondylia websteri* Felt

Hosts: *S. chinensis*; also *Medicago sativa*, *Parkinsonia* spp. and other leguminous plants (Fabaceae). Distr.: on jojoba in California, Arizona and Baja California. Gagné and Woods 1988, Pinto and Frommer 1980.

Smilacaceae

Smilax (greenbrier)

1a Inside stem or in spheroid galls on roots …… *Neolasioptera* sp.

The stem shows some discoloration in late season but no enlargement. The larva lives along the pith of the stem and overwinters in place inside a cocoon. Host: *S. anceps*. Distr.: Iowa. See on BugGuide.

1b Leaf galls …… 2
2a Flat, circular leaf spot, Plate 80 (2a) …… *Meunieriella* sp.

Spots are 5-6 mm in diameter. The single larva in each is visible beneath a thin layer of discolored epidermis covering the circle. The fully developed larva drops to the soil after

which the gall turns brown and becomes more noticeable from the top surface. This species has several generations per year. New galls can be found throughout the season on new growth. Felt (1918a) mistakenly attributed the galls to *Camptoneuromyia rubifolia* Felt. Hosts: *Smilax* spp. Distr.: Massachusetts to Maryland and West Virginia. Eiseman 2025a.

2b Reddened, marginal leaf roll, Plate 80 (2b) ..... *Dasineura smilacifolia* Felt

Rolled margins are commonly seen in early spring. Each contains one to several larvae. Hosts: *Smilax* spp. Distr.: Massachusetts to Florida.

Solanaceae

Capsicum (pepper)

1a Bud, flower, or fruit gall ..... *Asphondylia* sp.

This species is known from adults and pupae intercepted on pepper at the United States-Mexico border and at a seaside port of entry on peppers grown in The Netherlands. The niche of this species is unknown, but it likely prevents proper flower and fruit development. Host: *C. annuum*. Distr.: unspecified, presumably Neotropical.

1b Stem or leaf galls 2
2a Succulent, hemispherical galls of stem, leaf, or pedicel, see Image 105 ..... *Clinodiplosis capsicum* Gagné

This pest of peppers can be found year-round in the Neotropics and may eventually be found in warmer parts of the United States also. Each swelling bears one larva in a chamber where pupation ultimately occurs. Following emergence of the adults, the galled areas swiftly rot. Host: *C. annuum* (sweet pepper), *C. frutescens* (hot pepper). Distr.: Costa Rica, Guadeloupe, French Guiana. Gagné et al. 2000.

2b Fusiform stem swelling ..... *Neolasioptera capsici* Möhn

Larvae live in longitudinal chambers inside the stems. Hosts: *C. baccatum*, *Capsicum* sp. Distr.: Texas, Mexico (unspecified, intercepted at USA-Mexico border), El Salvador.

Lycium (desert thorn)

"*Cecidomyia*" *torreyi* Felt (1925) was named with reference to a female reared from an unspecified gall on *L. torreyi* from New Mexico (Cockerell 1902). The type, residing in the USNM, belongs to the Lasiopteridi but it is not possible at this time to assign it to genus.

1a Swollen stem ..... *Neolasioptera* sp.

This record is based only on the gall, which may likely be formed by a *Neolasioptera*. Host:

L. torreyi. Distr.: New Mexico.

1b Axillary, cabbage-like galls …… cecidomyiid

The gall is made up of overlapping, broad-based bracts. The larval chamber walls are hard and about 1-2 mm thick. Galls are polythalamous, the larvae pupate in the galls and adults emerge in spring. Host: *L. cooperi*. Distr.: California. Russo 2021.

Lycopersicon (tomato), see ***Solanum***

Nicotiana (tobacco)

Swollen stem …… *Neolasioptera* sp.

Host: *N. tabacum*. Distr.: Utah.

Solanum (nightshade)

1a Swollen stem, see Image 106 …… *Lasioptera solani* (Felt)

This species evidently has more than one generation per year, at least in New Mexico where adults were reared in the same season galls were found. Host: *S. carolinense*, *S. elaeagnifolium*. Distr.: West Virginia, Maryland, North and South Carolina and New Mexico.

1b Larvae in curled young leaves or fruit …… 2
2a Larvae in curled young leaves …… *Prodiplosis longifila* Gagné

Larvae feed gregariously in curled sections of the youngest leaves, develop rapidly and drop to the soil when full-grown. Host: *S. carolinense*; also, *Gossypium* spp. and *Citrus*; in South America, various Solanaceae (including potato), Chenopodiaceae, Fabaceae and Euphorbiaceae. Distr.: Virginia, Florida; also Colombia to Peru. Gagné 1986b & 1994, Hernandez et al. 2015.

2b Larvae in fruit or fruit stalk …… *Lasioptera kallstroemia* Felt and *Neolasioptera* spp.

L. kallstroemia. This species is evidently a generalist and possibly an inquiline. Hosts: *Solanum lycopersicum*, *Solanum* spp.; also *Kallstroemia* spp. (Zygophyllaceae). Distr.: Texas to Central America. Painter 1935.

Neolasioptera sp. This undescribed species was taken from what appears to be a fruit stalk swelling in South Carolina and from fruit galls in Mexico. Host: *Solanum* sp. Distr.: South Carolina and Mexico (interceptions on at least six occasions at the Mexico-USA border).

Neolasioptera sp. This second species of the genus on *Solanum* was reared in association with *L. kallstroemia*. Host: *S. lycopersicum*. Distr.: Sinaloa.

Staphyleaceae

Staphylea (bladdernuts)

Apical meristem gall …… *Dasineura* sp.

Apical buds are reduced to globular, leafy masses covering free-ranging white larvae. These probably drop to the soil to pupate. Host: *S. trifolia*. Distr.: Iowa. See on BugGuide.

Styracaceae

Halesia (silverbell)

Circular, light gray leaf spots …… *Clinodiplosis* sp.

Nothing more is known of this item. Host: *H. carolina*. Distr.: Florida.

Tamaricaceae

Tamarix (tamarisk)

Twig swellings …… *Psectrosema* spp.

This is a genus of 26 species restricted to tamarisk and vknown from the Mediterranean Region through central Asia to China. *Psectrosema* spp. have been tested abroad for host specificity and may one day be introduced into southwestern North America to aid in the control of tamarisk. Known species have two or more generations per year. Larvae pupate in the galls. Host: *Tamarix* spp. Gagné et al. 1996.

Ulmaceae

Planera (water elm)

1a Spheroid, hairy swelling along leaf midrib …… cecidomyiid

Galls are on the upper leaf surface, monothalamous, succulent, with long, white, cottony covering. Host: *Planera aquatica*. Distr.: Mississippi. See on iNaturalist.

1b Elongate, smooth, thick swelling along midrib …… cecidomyiid

Galls are polythalamous, elongate, midrib swellings, visible on both sides of a leaf. Galls

eventually open along their length on the upper side of the leaf. Host: *Planera aquatica*. Distr.: Mississippi. See on iNaturalist.

Ulmus (elm)

1a Galls on leaves 2
1b Galls on flowers or buds 3
2a Leaf pouch, occasionally greatly distorting leaf, Plate 98 (3) ... *Janetiella ulmii* (Beutenmüller)

Larvae live singly or gregariously in concave, often closed depressions or pouches open to the upper surface of the leaf and visible as convex swellings on the under surface of the leaf. These galls first appear in early spring. Full-grown larvae drop to the soil and adults emerge a few weeks later. Several generations may occur per year. Host: *U. americana*. Distr.: Ontario to Maryland.

2b Leaf spot, see Image 107 ..... *Dasineura* sp.

The barely elevated blister 2 mm in diameter can be seen on the upper side of the leaf in late April to early May in Maryland. A single larva lies uncovered in a depression on the underside of the leaf. The spot is at first green but turns black after the larva leaves. Host: *U. rubra*. Distr.: Maryland.

3a Malformed, aborted samara, Plate 98 (2), see Image 108 ..... *Primavera porrecta* (Felt)

Adults emerge from the soil in the first week of March in central Maryland and mate near the ground or on the base of the tree trunk. Females lay rafts of eggs on burgeoning flower buds. In large infestations the red eggs give a red cast to the buds. About a week later, newly hatched larvae crawl from the bud scales to the developing ovaries where they settle. Plant tissue envelops the larvae to form swellings with tightly closed lips lined with white hairs. One or more larvae may live in a pocket within a swelling. In late April the full-grown larvae drop to the soil, where they remain until the following spring. Host: *U. americana*. Distr.: Maryland, West Virginia, Wisconsin and Iowa. Gagné 2002.

3b Enlarged bud 4
4a Enlarged leaf bud, Plate 98 (1a) ..... *Dasineura ulmea* Felt

A damaged bud is filled by a single larva or pupa in spring. Adults emerge in early spring when normal buds are bursting. This species is univoltine. Host: *U. americana*. Distr.: Massachusetts to Maryland, west to Illinois. Houser 1916.

4b Enlarged stem bud, Plate 98 (1b) ..... *Dasineura* sp.

This species has a two-year life cycle. In early spring buds fail to elongate normally and develop into a leafy growth about 1 cm in length and diameter. The active larvae live in bulblet-like galls and grow slowly. They remain in the first instar through the first winter until early July, when the outer bud scales turn brown and rough. Larvae enter the second

instar in about mid-August and the third toward the end of September. In spring of the following year, larvae form a cocoon in which they pupate. Adults appear a short time later. Host: *U. rubra*. Distr.: Maryland.

Urticaceae

Boehmeria (false nettle)

Tapered stem swelling …… *Neolasioptera boehmeriae* (Beutenmüller)

Swellings are 1-2 cm long and turn woody in fall. Larvae overwinter in the stems and adults emerge the following spring. Host: *B. cylindrica*. Distr.: Ontario to Maryland, Oklahoma.

Laportea (laportea)

Laportea and *Urtica* host a group of related species of *Dasineura* that cause complex galls on leaves, stems and flowers. Larvae are characterized by a shortened spatula and the presence of only four instead of the usual eight papillae on the terminal segment. When full-grown, larvae leave the galls and form cocoons in the soil. Some species have more than one generation per year. Even though galls are quite common on *Laportea* in Maryland, I have not found any there on *Urtica*, but two kinds have been recorded from *Urtica* in New York. This species group appears to be Nearctic and closely host specific. In Europe two *Dasineura* species are known from *Urtica*, but one forms a simple leaf roll, the other a succulent pouch gall.

1a Indehiscent stem or bud galls …… 2
1b Dehiscent, regularly spheroid or ovoid galls, narrowly connected to plant or situated in socket… …… 3
2a Succulent, globular, broad-based node and bud gall, Plate 95 (5) … *Dasineura involuta* Plakidas

Galls are green, smooth, up to 1 cm in diameter, usually polythalamous, and can be found from June to October. At least two generations occur per year. Host: *L. canadensis*. Distr.: Iowa, Ontario to Pennsylvania and New York.

2b Hard, slight swelling of stem …… *Neolasioptera* laporteae Plakidas

Host: *L. canadensis*. Distr.: Iowa, Pennsylvania.

3a Spherical, fuzzy, petiole or stem gall set into socket, Plate 95 (4b) … *Dasineura pilosa* Plakidas

Galls are white to purplish and monothalamous. Host: *L. canadensis*. Distr.: Pennsylvania, Maryland.

3b Ovoid, smooth, translucent gall with short terminal nipple, connected to plant by narrow pedicel, Plate 95 (4a), see Image 109 …… *Dasineura investita* Plakidas

Galls are green and monothalamous. Commonly found on leaves in June, the galls can be seen also on petioles, stems and flower parts later in summer. At least two generations occur per year. Host: *L. canadensis*. Distr.: Ontario to Maryland.

Parietaria (pellitory)

Swollen stems and branchlets …… *Neolasioptera* sp.

Galls were found in August. Host.: *P. pensylvanica*. Distr.: Oklahoma. See on BugGuide.

Pilea (clearweed)

Tapered stem swelling …… *Neolasioptera* sp.

Swellings are 1-2 cm long and turn woody in fall. Larvae overwinter in the stems and adults emerge the following spring. Host: *P. pumila*. Distr.: Maryland.

Urtica (nettle)

See general remarks under *Laportea*.

1a Bud gall …… *Dasineura* sp.

The affected bud, visible at flowering time, is about 10 mm in diameter and made up of overlapping leaves. Larvae are gregarious and whitish. Host: *U. dioica*. Distr.: Washington, Montana. Russo 2025.

1b Leaf galls …… 2
2a Smooth, turbinate leaf gall …… *Dasineura urnicola* (Osten Sacken)

Galls are monothalamous, green, succulent, about 3 mm high, subsessile, with a short nipple at the upper truncate end. They dehisce when the larvae inside are full-grown. Host: *U. dioica*. Distr.: New York.

2b Hairy, grayish, ovoid leaf gall …… *Dasineura* sp.

Galls are about 3 mm high, monothalamous and dehiscent when the larvae are mature. Host: *U. dioica*. Distr.: New York.

Verbenaceae

Duranta (duranta)

Enlarged, aborted flowers …… *Asphondylia* sp.

This species is known from a series of adults in the USNM. Host: *D. erecta*. Distr.: Florida.

Glandularia (mock vervain)

Swollen stem apex with single large chamber, see Image 110 ..... *Neolasioptera* sp.

Galls occur just below the flowers, are 3 cm long by 1 cm broad, one-chambered and contain gregarious larvae. In mid-October, orange, full-grown larvae were found in individual silken cocoons. Some larvae had already pupated. Host: *G. bipinnatifida*. Distr.: Arizona. Russo 2021.

Lantana (lantana)

1a Enlarged, aborted flowers ..... *Asphondylia camarae* Möhn

Host: *L. camara*. Distr.: Jalisco; also El Salvador and Panama.

1b Galls on stems or leaves 2
2a Tapered stem swelling ..... *Neolasioptera* sp.

Host: *L. urticoides*. Distr.: Texas.

2b Fuzzy, spheroid leaf gall ..... *Schismatodiplosis lantanae* (Rübsaamen)

Galls are hemispherical on each leaf surface but appear larger on the upper. Hosts: *Lantana spp*. Distr.: Vera Cruz, Tabasco and Quintana Roo; also, Trinidad and Brazil.

Verbena (vervain)

1a Enlarged, aborted flower ..... *Asphondylia verbenae* Felt

Infested flowers are about 5 mm long and 2 mm in diameter. The gall consists of the aborted ovary and the lower corolla tube. Galls remain on the plant until normal buds mature into fruit. Adults emerged from the galls in October. Host: *V. halei*. Distr.: Texas. Painter 1935.

1b Stem or leaf swelling or marginal leaf roll 2
2a Stem or leaf base swelling ..... *Neolasioptera* spp.

N. verbenae (Felt). Swellings about 1 cm long occur in the flower stalk. Host: *V. lasiostachys*. Distr.: California.

Neolasioptera sp. This species may be the same as *N. verbenae*. Galls occur just below the inflorescence. They are 30 mm long by 10 mm wide and distinguished by sparse, long, scraggly white hairs and prominent, raised vertical ridges. In October orange larvae may be found inside the stems in tightly packed silken cocoons. The interior walls are covered then by the black-gray excrescence of the symbiotic fungus. Host: *V. bipinnatifida*. Distr.:

Arizona. Russo 2021.

Neolasioptera sp. Swellings are 3-5 mm long and usually at the base of leaves. This species is known only from a larva distinct from that of *N. verbenae*. Host: *V. hastata*. Distr.: Ontario.

Neolasioptera sp. Galls are woody, fusiform stem swellings about 1 cm long and noticeably wider that normal stems. They occur just under a node on main or lateral stems. In late summer each gall contains one or two orange larvae in brown cocoons covered with black fungal remains which fill the rest of the enclosure. A tunnel points upwards through the base of a leaf scar. Whether this species fits any of the species above is unknown. Host: *V. urticifolia*. Distr.: Iowa, Wisconsin.

2b Marginal leaf roll, Plate 45 (3) ..... *Clinodiplosis verbenae* (Beutenmüller)

Infested young terminal leaves become deformed and twisted. Full-grown larvae drop to the ground to pupate. Several generations occur per year. Host: *V. hastata*. Distr.: New York, New Jersey and Iowa. See on BugGuide.

Viburnaceae

Sambucus (elderberry)

1a Tapered stem swelling ..... *Neolasioptera pierrei* (Gagné)

Swellings vary in size depending on the number of larvae within. Larvae develop separate tunnels. Adults emerge from the galls in spring. Host: *S. canadensis*. Distr.: Massachusetts to Florida.

1b Bud or flower galls 2
2a Swollen bud ..... *Asphondylia sambuci* Felt

Galls are reportedly greenish-white, 1.5 cm diam., with two thickened, projecting bracts. Host: *S. nigra*. Distr.: Maryland.

2b Enlarged, unopened flower, Plate 46 (8) ..... *Schizomyia umbellicola* (Osten Sacken)

Galls are appreciably larger than normal flower buds. The single larva in each gall is orange and very active. It drops to the ground when full-grown and enters diapause until the next spring. Another cecidomyiid, *Youngomyia podophyllae* (Felt), an inquiline whose role in the gall is unknown, has been reared from these galls and those of other *Schizomyia* as well. Host: *S. canadensis*. Distr.: eastern half of United States.

Viburnum (viburnum)

1a Leaf gall 2

1b Bud, flower, or stem gall 4
2a Marginal leaf roll ..... *Contarinia* sp.

This is an undescribed species found on *V. nudum* and mentioned only as "*Cecidomyia* sp." in Felt (1918a, 1940, 1965). The leaf roll is about 1 cm long. According to Felt's unpublished notes, the larva, one in each roll, drops to the ground when full-grown. Similar damage with white, mature *Contarinia* larvae has been reported from Oklahoma. Hosts: *V. nudum*, *V. rufidulum*. Distr.: New York, Oklahoma.

2b Circular blister gall or vein swelling 3
3a Circular blister gall, Plate 46 (9b) ..... *Sackenomyia commota* Gagné

Galls are biconvex and red, green or white. One larva, rarely two, very active when disturbed, can be found in each blister. Full-grown larvae are red and exit the gall through a weak, circular area on the upper leaf surface. This species evidently has several generations per year. Larvae were observed leaving the galls in mid-May in central Maryland. Possibly more than one species causes galls on the recorded hosts. Hosts: *V. acerifolium*, *V. nudum*, *V. dentatum*, *V. obovatum*, *V. opulus*. Distr.: eastern United States.

3b Purplish vein swelling, Plate 46 (9a) ..... *Sackenomyia viburnifolia* Felt

The biology of this species generally resembles that of *S. commota* except that the larvae, perhaps more constrained in the narrower galls, do not appear as active. Adults were reared in May from larvae taken from the previous year's galls, but galls can be found throughout the summer. Host: *V. dentatum*. Distr.: northeastern United States.

4a Enlarged blossom or bud ..... *Schizomyia viburni* Felt and *Contarinia* sp.

S. viburni. This species is known from a female "about to oviposit in flowers," but Felt (1918a, 1940, 1965) later associated it with an unspecified bud gall. A flower gall is made by another *Schizomyia* on *Sambucus*, so *S. viburni* may come from enlarged flowers as well. Host: *Viburnum* sp. Distr.: New York.

Contarinia sp. The gregarious white larvae were found inside enlarged, closed flowers. Host: *V. edule*. Distr.: Alaska (Kenai Peninsula).

4b Swollen stems, Plate 46 (10) ..... *Neolasioptera viburnicola* (Beutenmüller)

Galls are gnarly, 3-8 cm long and soft-pithy inside. The orange larvae live in separate channels and overwinter in the galls. Host: *V. dentatum*. Distr.: New York, Connecticut and Virginia.

Violaceae

Viola (violet)

1a Rolled, thickened and deformed leaf …… *Prodiplosis violicola* (Coquillett) and *Dasineura* sp.

P. violicola. Eggs are laid before leaves unfold. Larvae curl the upper leaf edge toward the midrib. When full-grown, larvae drop to the ground to pupate. Several generations occur per year. This species was once a major pest of cultivated violets in greenhouses. It occurs also on wild violets. Hosts: *Viola* spp. Distr.: Minnesota to Connecticut, south to Virginia. Garman 1922.

Dasineura sp. A western North American species, it causes an upward curling and thickening of violet leaves. The European *Dasineura affinis* (Kieffer) causes a similar deformation but whether the two are synonymous is unknown. Hosts: *Viola glabella*, *Viola* spp. Distr.: British Columbia to California. Russo 2021.

1b In enlarged, deformed fruit or petiole …… 2
2a In enlarged, deformed fruit …… *Dasineura semenivora* (Beutenmüller)

Infested fruit are onion-shaped, green and 6-15 mm in diameter. Larvae live in individual chambers within the fruit and overwinter within a cocoon. Evidently only one generation occurs per year. Hosts: *Viola* spp. Distr.: Ontario and Massachusetts to New Jersey.

2b Inside petiole …… *Neolasioptera* sp.

Larvae live singly inside the petiole and eventually form a cocoon in which they overwinter. Their presence is indicated only by a blackening in the immediate vicinity of the larva. Host: *Viola* sp. Distr.: Iowa. See on BugGuide.

Vitaceae

Parthenocissus (creeper)

1a Swollen midrib fold …… *Dasineura parthenocissi* (Stebbins)

Swellings are stiff, thick-walled, usually about 15 mm long. Larvae are gregarious within the folds and drop to the soil when full-grown. Host: *P. quinquefolia*. Distr.: Massachusetts to Ontario, south to Maryland.

1b Spheroid to elongate-cylindrical, corky swelling emanating from branches, see Image 111 …… …… *Neolasioptera psederae* Felt

Swellings are polythalamous, 5-25 mm long. They appear to be modified tendrils. Larvae overwinter in the galls. Host: *P. quinquefolia*. Distr.: Ohio, Georgia, Florida.

Vitis (grape)

1a Deformed flowers or berries 2
1b Gall on other plant parts 3
2a Deformed flower ..... *Contarinia johnsoni* Felt

Grape blossom midge. Eggs are laid in opening flower buds. Larvae live gregariously in developing flowers and prevent fruit set. Full-grown larvae drop to the soil where they remain until the following spring. In New York during the first decade of the 1900's, this species was a notable pest of certain varieties of cultivated grape. *Contarinia viticola* Rübsaamen damages grape similarly in Europe and may be the same species. Hosts: *Vitis* spp., cultivated American varieties. Distr.: New York, Quebec. Hartzell 1910.

2b Swollen berry, the seed aborted, see Image 112 ..... *Asphondylia uvarum* Gagné

Larvae can be found damaging berries in spring in Texas. Pupation occurs inside the grapes and adults emerge in June. An alternate host for the next generation is unknown. This pest has otherwise occasionally been intercepted at the United States-Mexico border. Hosts: *Vitis* spp. (cultivated). Distr.: Texas, Coahuila. Gagné et al. 2018.

3a Woody, spindleform swelling of tendril, petiole, or midvein, Plate 99 (2, g) .... *Neolasioptera vitinea* (Felt)

Swellings are 5-25 mm long and several may occur in tandem. One or more larvae live along the pith under each swelling. One generation occurs per year. Adults emerge from the galls the following spring. Hosts: *Vitis* spp. Distr.: widespread southeastern Canada and eastern United States.

3b Complex gall on node or leaf, or simple leaf spot or blister 4
4a Complex galls on node or spinelike leaf gall, Plate 99 (2c, e, h, 3) ..... *Ampelomyia* spp.

Three American species of *Ampelomyia* (placed until recently in *Schizomyia*) have been described from spinelike or nutlike, single or clustered, dehiscent galls on grape. The spinelike galls shown on Plate 99 (2c, e) usually occur on the leaves, each with a single larva in an elongate chamber. The others are polythalamous, each larva in its own chamber. Polythalamous galls always occur at a node, are fleshy at first and become woody. *A. viticola* (Osten Sacken) comes from leaf galls (2c); *A. vitiscoryloides* (Parkard) from clustered, ``hazelnut'' galls (2h); and *A. vitispomum* (Osten Sacken) from spheroid "apple" galls (3). Galls fall off the vines in August with the larvae still inside. Galls of the last two species are not only variable in shape but some are smooth and shiny, others fuzzy. Whether this is due to the species of grape or variability of the gall midge is unknown. All three of those species are found in eastern North America. In addition, *Schizomyia petiolicola* Felt, not treated further here, was reportedly reared in New York from a tapered stem swelling attributable to *Neolasioptera vitinea*, but I have never seen *Schizomyia* larvae in such galls. The record was possibly based on contamination in a rearing container. Hosts: *Vitis* spp. Distr.: eastern half of North America.

4b Irregular, succulent swellings on various plant parts or circular spots or blisters on leaves 5

5a Irregularly spheroid, succulent, usually red swelling on leaf, tendril, or flower, Plate 99 (1) …… …… *Vitisiella brevicauda* and miscellaneous cecidomyiids

Vitisiella brevicauda (Felt). This is the species responsible for the galls. It has two or more generations per year. Full-grown larvae cut a hole to the exterior and drop to the soil to pupate. Galls are sometimes so abundant as to deform whole leaves and flower clusters. Hosts: *Vitis* spp. Distr.: Widespread North America. Johnson 1952, Gagné 2009b.

Brachineura vitis Felt. This species, presumably a mycophage, was reared on one occasion. Host: *Vitis* sp. Distr.: New York.

Dasineura vitis Felt. This is evidently an inquiline and has two or more generations per year. Hosts: *Vitis* spp. Distr.: New York, North Carolina. Gagné 2009b.

Lasioptera vitis Osten Sacken. This inquiline is reared occasionally from these galls. Hosts: *Vitis* spp. Distr.: Massachusetts to Maryland. Johnson 1952.

Rhizomyia vitis (Felt). Reared in spring from a jar containing old galls, this species presumably feeds in detritus. Distr.: New York.

5b Circular, flat or regularly convex leaf galls or spots, .05 mm diam. or less, some with woolly covering on the underside …… 6

6a Circular, flat or regularly convex spot on leaf, some with a variously woolly covering on the underside, Plate 99 (2a, b, d), see Image 113 …… *Vitisiella* spp.

Several apparently undescribed species are responsible for various kind of galls on grape leaves, one of them illustrated here. These species will need a comprehensive study before they can be understood. *Lauthia arizonensis* (Felt), presumably mycophagous and possibly fortuitous, was reared once in Arizona from small, 2 mm diameter, warty bumps. Hosts: *Vitis* spp. Distr.: Various kinds can be found throughout North America.

6b Convex but irregularly lobed galls, see Image 114 …… …… *Daktulosphaira vitifoliae* (Hemiptera: Phylloxeridea)

This gall is made by the grape phylloxera, added here to differentiate from more regularly-shaped gall midge galls and because it is host to cecidomyiid predators that feed on the bug. In one season's very large population of the pest that I observed, I regularly reared *Lestodiplosis grassator* (Fyles), one other *Lestodiplosis* and a *Clinodiplosis* in about equal numbers. The last was observed feeding on the bug, so that genus has to be counted among predaceous gall midges. Larvae of the first two species were red, the third, white. These predators were very plentiful and present in every gall that I opened, perhaps the reason that no grape phylloxera galls could be found at the site the following year. Host: *Vitis rotundifolia*. Distr.: West Virginia.

Zygophyllaceae

Kallstroemia (caltrop)

Swollen stem or inflorescence ..... *Lasioptera kallstroemia* Felt

Stem swellings are about 10 mm long and 5-9 mm in diameter and are usually found at the nodes. Late-season galls may occur also on the inflorescence and cause the fruit to abort. Adults were reared in fall from both node and inflorescence galls. This species has also been reared from *Solanum* in Mexico, so is evidently a generalist. Host: *K. parviflora*; also *Solanum* (Solanaceae). Distr.: Texas to Central America. Painter 1935.

Larrea (creosote bush)

Seventeen species of gall midges are known from *L. tridentata*. Fifteen of them belong to a monophyletic group of *Asphondylia* that forms galls on flowers, stem nodes and leaves (Waring & Price 1989, Gagné and Waring 1990). The remaining two species belong to *Contarinia*, both yet unnamed: one of them causes a pair of leaves to widen and adhere at their edges to cover a weakly convex, circular chamber (Plate 100 (6)); the other lives in flowers. The genus *Larrea* is a desert disjunct, with a single species known from southwestern North America and four from southern South America. Gagné & Boldt (1991) could report only a single, unidentified cecidomyiid species from *Larrea* in Argentina that had no connection to those of North America. Unlike most species of *Asphondylia*, those from *Larrea* have no apparent symbiotic fungus. Joy & Crespi 2007.

The host is not repeated at each entry below, nor are references. For original and/or general information, see Waring & Price 1989 and Gagné and Waring 1990; for additional records and photographs of *Larrea* galls from California, see Russo (2021).

1a Open flower with gregarious larvae or pair of enlarged, appressed leaves filled with a sticky substance 2
1b Complex leaf or bud galls 3
2a Open flower with gregarious larvae ..... *Contarinia* sp.

Larvae are gregarious and free-ranging in the flower. Pupation occurs in situ. Distr.: Arizona.

2b Pair of circular, appressed leaves situated at tips of branches, filled with a mucillaginous substance, Plate 100 (6) ..... *Contarinia* sp.

The opposing, convex and closely appressed leaves harbor a single larva. Distr.: Arizona, New Mexico, Texas.

3a Bud galls 4
3b Leaf galls 10
4a Galls the result of foreshortened stems, bearing numerous leaf remnants 5
4b Galls simple modified buds, without leaf remnants 8
5a Gall spheroid, coated in hard, brown resin incorporating leaves, Plate 100 (8) ... *Asphondylia resinosa* Gagné

Distr: California, Arizona, New Mexico.

5b Gall not covered in resin, the leaves free …… 6
6a Gall a spherical body of narrow leaves covering a mass of larval chambers , Plate 100 (1) …… *Asphondylia auripila* Felt

Distr: California, Arizona, New Mexico.

6b Gall a foreshortened stem with single, integral larval chamber …… 7
7a Gall spheroid, fuzzy, only ends of leaves apparent, Plate 100 (2) … *Asphondylia foliosa* Gagné

Distr: California, Arizona.

7b Gall elongate, leaves entirely visible, Plate 100 (3) …… *Asphondylia rosetta* Gagné

Distr: California, Arizona.

8a Spherical node gall placed in socket, Plate 100 (5) …… *Asphondylia bullata* Gagné

Distr: Arizona.

8b Leaf or flower bud gall … 9
9a Modified leaf gall at apical bud, Plate 100 (4) …… *Asphondylia apicata* Gagné

These galls are usually found near terminal buds. Two generations per year are possible.
Distr: California, Arizona.

9b Modified flower gall, Plate 100 (7) …… *Asphondylia florea* Gagné

Distr: California, Arizona, New Mexico.

10a Gall supine, with hairless patch at base, fuzzy beyond …… 11
10b Gall erect, uniformly hairless or fuzzy …… 12
11a Gall short fuzzy for slightly more than 1/2 length, Plate 101 (1) … *Asphondylia barbata* Gagné

Distr: California, Arizona, New Mexico, Texas.

11a Gall long fuzzy for almost entire length, Plate 101 (2) …… *Asphondylia villosa* Gagné

Distr.: Arizona, New Mexico, Texas.

12a Gall clavate …… 13
12b Gall discoid or widest near midlength …… 14
13a Gall fuzzy, Plate 101 (5) …… *Asphondylia pilosa* Gagné

Distr: California, Arizona.

13b Gall naked, Plate 101 (7) ..... *Asphondylia clavata* Gagné

Distr: California, Arizona, New Mexico, Texas.

14a Gall digitate, Plate 101 (8) ..... *Asphondylia digitata* Gagné

Distr: Arizona.

14b Gall entire 15
15a Gall ovoid, biconvex, Plate 101 (3) ..... *Asphondylia discalis* Gagné

Distr: California, Arizona, New Mexico.

15b Gall cylindrical … 16
16a Gall widest near middle, Plate 101 (4) ..... *Asphondylia silicula* Gagné

Distr: California, Arizona.

16a Gall widest at base, Plate 101 (6) ..... *Asphondylia fabalis* Gagné

Distr: California, Arizona

Porlieria (lignum-vitae)

1a Larvae between paired, swollen leaflets ..... *Dasineura* sp.

Host: *G. angustifolium*. Distr.: Texas.

1b Larvae with flowers or fruit 2
2a Larvae feeding freely in flowers ..... cecidomyiid

This is an unplaced species of Cecidomyiidi. Host: *G. angustifolium*. Distr.: Texas.

2b Larvae in swollen, aborted flower buds or swollen pods ..... *Asphondylia* sp.

Whether one or two species make the separate kinds of damage is unknown. Host: *G. angustifolium*. Distr.: Texas.

Glossary

Anatomical terms defined here are mainly those peculiar to Cecidomyiidae or their galls. Terms that pertain to Diptera in general may be found in McAlpine et al. (1981) or in a general entomology textbook. Botanical terms not defined here can be found in a general botany textbook or a dictionary.

allopatric occurring in separate geographic areas.
bivoltine having two generations per year.
blister as in ``leaf blister''; a convex, ovoid to circular area caused by one or more larvae in a concavity on the underside of a leaf or inside leaf tissue.
circumfilum (pl.: *circumfila*) threadlike, continuous, sensory processes of antennae of adults, derived from forked nerve cells, each resulting tine connected at its apex with that of a neighboring cell; peculiar to Cecidomyiidae.
diapause a state of dormancy that interrupts development of an immature stage of the life cycle.
dimorphism condition of having two different kinds of structure.
empodium (pl.: *empodia*) the pad situated between the two tarsal claws.
fascicle the needle bundle of conifers.
flagellum (pl.: *flagella*) the antenna exclusive of the basal two segments and formed of 8-25 or more flagellomeres.
flagellomere individual article of the flagellum.
fold inpocketing of a leaf blade between veins (leaf fold) or along a vein (vein fold).
fungivorous feeding on fungi.
fusiform tapered at both ends, spindleform.
gall a predictable and consistent plant deformation that occurs in response to feeding or other stimulus by a foreign organism.
  complex gall the result of tissue that is completely reorganized into a shape that is fundamentally different from any structure normally found on the plant.
  simple gall a gall that does not differ from normal plant tissue except that the tissue is swollen, rolled, or otherwise marked or distorted.
imbricated overlapping, as with the shingled bracts or leaves forming the outer part of some galls.
inquiline an organism that may regularly be found in particular galls but does not cause the gall.
instar the larva between molts; gall midges have three larval instars.
monophagous feeding on one species of host.
monophyletic containing species or other groups derived from a single ancestor.
monothalamous condition of a complex gall that has a single larval cell.
multivoltine having three or more generations per year.
mycophagous feeding on fungi.
oligophagous feeding on a few closely related species of hosts.
pedogenetic reproducing during the larval stage.
papilla (pl.: *papillae*) dermal sense organ of a larva, usually associated with individual setae.
paraphyletic not containing all descendants of a single ancestor.

pheromone an intraspecific chemical signal.
phytophagous feeding on plants.
polyphagous feeding on unrelated species of hosts.
polyphyletic containing species or other groups derived from unrelated ancestors.
polythalamous condition of a complex gall that has two or more discrete cells.
pouch gall a capacious fold of vein or leaf.
puparium (pl.: *puparia*) in gall midges, the second-instar larval skin when it becomes the cocoon for the third-instar larva and pupa.
roll, as in "*leaf roll*" a leaf formed into a cylinder
marginal leaf roll only the margin of the leaf formed into a cylinder.
samara a winged fruit.
sensoria sensory receptors.
setiform condition of a larval papilla that bears a seta.
spatula (pl.: spatulae (L.) or spatulas) a sclerotized, usually elongate, epidermal structure found on the venter of the prothorax of most third instars and, rarely, second instars.
spot, as in ``*leaf spot*'' a flat, ovoid to circular area; usually with one or more larvae in a concavity on the underside of a leaf or inside leaf tissue.
symbiont (adj.: *symbiotic*) an organism living in close association with another.
sympatric occurring in the same geographic area.
trichome a three-forked plant hair.
univoltine having one generation per year.

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Image Gallery

1. Midrib gall, *Polystichum acrostichoides*: cecidomyiid. Photo by J.D. Plakidas.

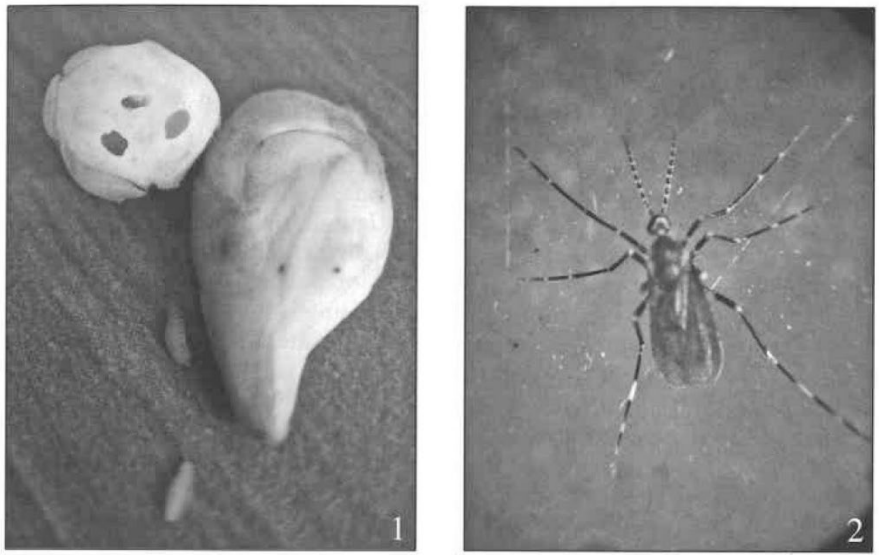
See in Text.

2. Leaf galls, *Avicennia germinans*: *Meunieriella avicenniae*. Photo by C. Feller.

See in Text.

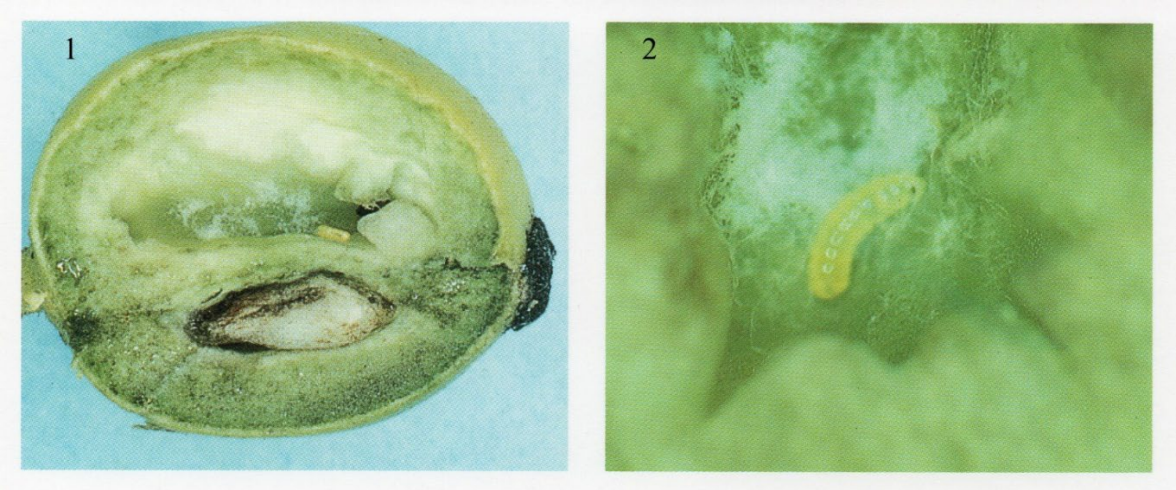
3. Fruit galls, *Zizia aurea: Asphondylia* sp. Photo by J.E. Steffen.

See in Text.



4. Flower galls, *Echites panduratus: Schizomyia loroco*, 1, Galls, one sectioned to show larval chambers, the freed larvae crawling away. 2, Female. Photos by M. Menjivar.

See in Text.

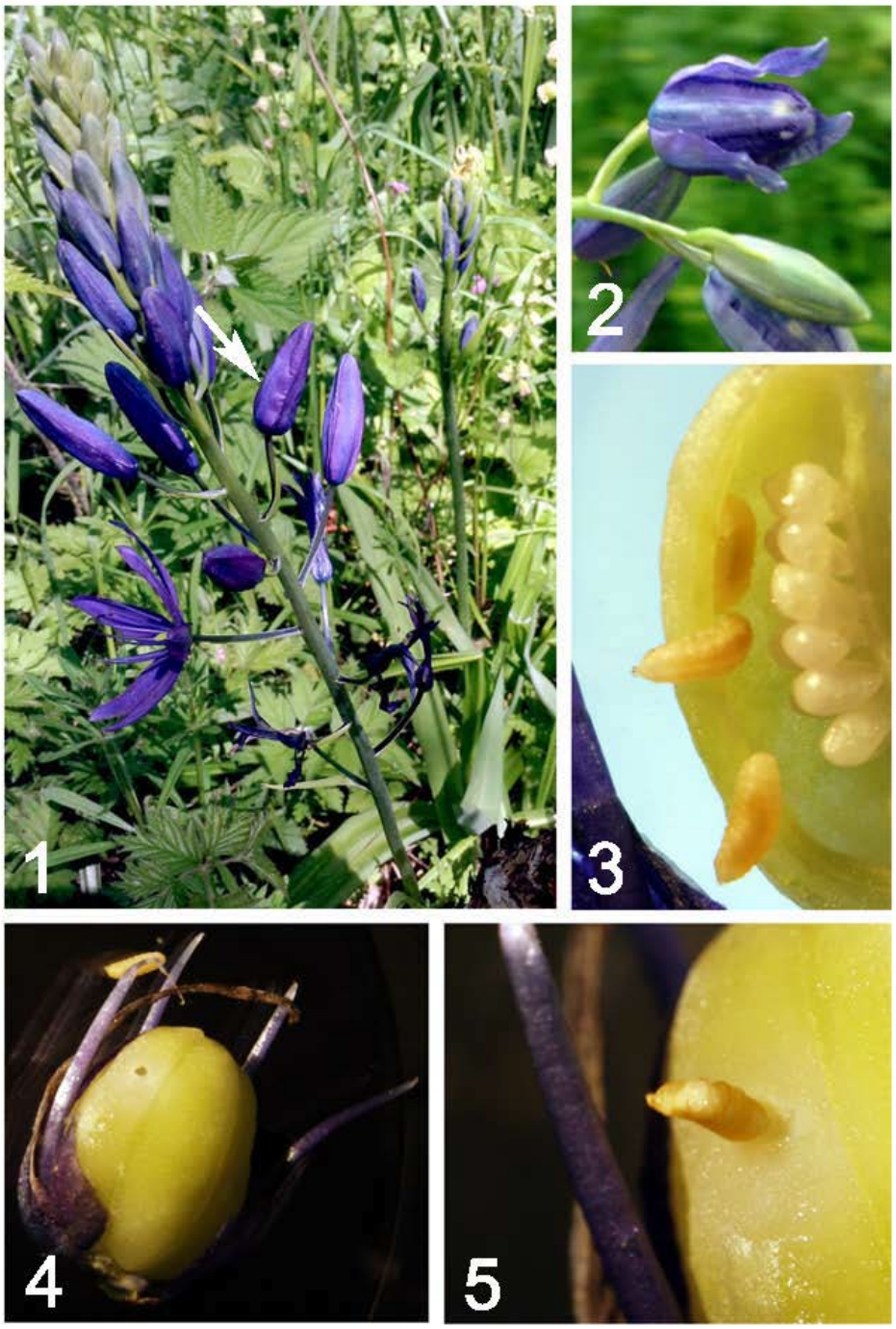


5. Aborted berry, *Ilex opaca*: *Asphondylia ilicicola*. 1, Longitudinal section. 2, Detail of first instar and fungus in aborted carpel. Gagné 1989b.

See in Text.

6. Leaf gall, *Ilex decidua*: *Contarinia* sp. Photo by M.L. Lewis.

See in Text.



7. Figs. 1-5. Flower galls, *Camassia leichtlinii*: *Dasineura camassiae*. 1, Normal open flower and closed flower gall (arrow) beginning to enlarge. 2, Rarer, tri-form galled flower. 3, Larvae on inside surface of newly dissected locule. 4, Mature gall with exit hole formed by larva. 5, One of several larvae observed escaping in succession from same hole of this gall. Note the circular shape and translucent coloration of the softened tissue around the exiting insect. Photos by T. Barosh.

See in Text.

8. Stem gall, *Tritelia laxa*: *Lasioptera* sp. Note pupal exuviae. Photo by R.J. Gagné.

See in Text.

9. Stem gall, *Ageratina altissima: Neolasioptera* eupatorii. Photo by R.J. Gagné.

See in Text.

10. Larvae in stem, *Ageratina altissima: Resseliella* sp.. Photo by J van der Linden.

See in Text.

11. Leaf swelling with exerted pupal exuviae, *Artemisia ludoviciana*: *Rhopalomyia* sp.. Photo by M. Palmer.

See in Text.

12. Leaf gall, *Artemisia ludoviciana*: *Rhopalomyia* sp.. Photo by M. Palmer.

See in Text.

13. Spheroid apical gall, *Bidens polylepis: Asphondylia ovata*. Photo by R.J. Gagné.

See in Text.

14. Apical bud gall, *Conyza canadensis*: *Asphondylia* sp.. Photo by M. Palmer.

See in Text.

15. Swollen flower galls, *Coreopsis tripteris*: *Asphondylia* sp. Photo by C. Mapes.

See in Text.

16. Modified flower head, *Corythrogyne filiginifolia: Asteromyia* sp. Photo by J. Bailey.

See in Text.

17. Modified flower head, *Echinacea pallida*: cecidomyiid. Photo by Y. Kemper.

See in Text.

18. Stem gall, *Erechtites hieracifolia*: *Neolasioptera sp*. Photo by R.J. Gagné.

See in Text.

19. Leaf cluster gall, *Solidago gigantea: Dasineura carbonaria*. Photo on right with sectioned gall showing orange larvae. Photos by R.J. Gagné.

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See in Text

20. Bud galls, *Gutierrezia* sp.: *Asphondylia* sp. Photo by R.J. Gagné.

See in Text.

21. Flower galls, *Helianthus occidentalis*: *Asphondylia helianthiflorae*. Photo by E. Pecher.

See in Text.

22. Leaf galls, *Helianthus annuus*: *Asphondylia* sp. Photo by M. Palmer.

See in Text.

23. Apical bud gall, *Palafoxia feavi*: *Asphondylia* sp. Photo by K.L. Hibbard.

See in Text.

24. Apical bud gall, *Pseudognaphalium californicum*: *Asphondylia* sp.. Photo by D.H. Headrick.

See in Text.

25. 1, Pulvinus gall, *Solidago altissima*: *Asteromyia* sp. 2, Same, sectioned to show larva. Photo by R.J. Gagné.

See in Text.

26. Apical bud gall, *Solidago rugosa*: *Asphondylia rosulata*. Photo by R.J. Gagné.

See in Text.

27. Apical bud gall modified by eulophid on *Solidago rugosa*: *Asphondylia rosulata*. Photo by R.J. Gagné.

See in Text.

28. Rachis galls, *Solidago sempervirens*: *Asphondylia* sp.. Photo by R.J. Gagné.

See in Text.

29. Flower galls, *Solidago nemoralis*: *Schizomyia racemicola*. Photo by R.J. Gagné.

See in Text.

30. Apical bud gall, *Symphyotrichum praealtum*: *Rhopalomyia* sp. Photo by M. Palmer.

See in Text.

31. Apical bud gall, *Symphyotrichum ericoides*: *Rhopalomyia* sp. Photo by M. Palmer.

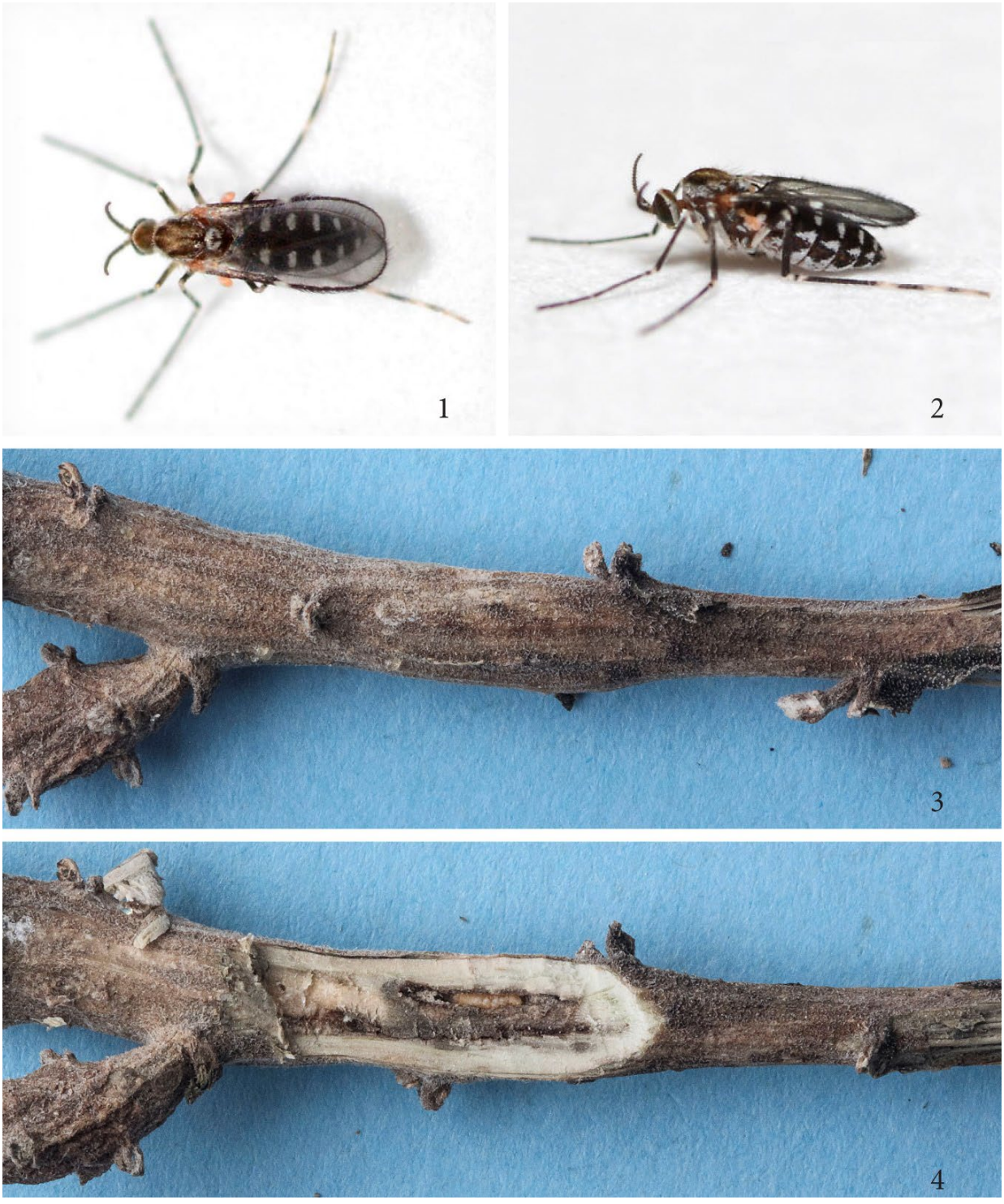
See in Text.

32. Floret galls, *Verbesina occidentalis*: *Schizomyia verbesinae*. Photo by R.J. Gagné.

See in Text.

33. Apical bud gall, *Verbesina alternifolia*: *Asphondylia* sp. Photo by R.J. Gagné.

See in Text.



34. Stem galls, *Verbesina alternifolia: Neolasioptera imprimata*. 1-2, Females; 3-4, Galls, one in section. Gagné & Palmer 2019.

See in Text.

35. Stem galls, *Verbesina alternifolia: Neolasioptera verbesinae*; 5, characteristic ovate galls; 6, gall sectioned, summer; 7, gall sectioned, winter, with formerly soft tissue shrunken, leaving hard, brittle tissue surrounding isolated larval tunnels. Gagné & Palmer 2019.

See in Text.

36. Leaf midrib galls, *Vernonia noveboracensis*: *Neolasioptera vernoniae*. Photo by R.J. Gagné.

See in Text.

37. Lateral bud gall, sectioned, *Vernonia noveboracensis*: *Asphondylia vernoniae*. Photo by R.J. Gagné.

See in Text.

38. Pedicel galls, *Vernonia noveboracensis*: *Neolasioptera* sp. Photo by R.J. Gagné.

See in Text.

39. Folded leaf veins, *Corylus americana*: cecidomyiid. Photo by S. Guida.

See in Text.

40. Larvae on nut (note larva in flexed jumping position), *Corylus cornuta*: cecidomyiid. Photo by S. Guida.

See in Text.

Lompoc Yerba Santa Bud Galls

41. Bud galls, *Eriodictyon californica*: *Asphondylia* sp. Photo by Z. Phillips.

See in Text.

42. Stem gall, *Heliotropium curassavicum*: *Neolasiptera* sp. Photo by E. Oey.

See in Text.

43. Root nodules, *Encyclia tampensis*: *Clinodiplosis cattleyae*. Photo by L. Crees.

See in Text.
See in Text.

44. Twig swelling, *Celtis occidentalis*: *Melanagromyza deserta* (Diptera: Agromyzydae). Photo by R.J. Gagné.

See in Text.

45. Branchlet galls, *Juniperus virginiana*: *Contarinia juniperina*. Photo by R.J. Gagné

See in Text.

46. Stem swelling, *Taxodium distichum*: *Cecidomyia lamellata*. Photo by K. L. Hibbard.

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47. Normal and malformed perigynia, *Carex squarrosa*: *Dasineura* sp. Photo by R.J. Gagné.

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48. Larvae at base of stem, *Carex* sp.: cecidomyiid. Photo by R.J. Gagné.

See in Text.

49. Leaf rosette, *Arctostaphylos pringeli*: cecidomyid. Photo by M. Claire.

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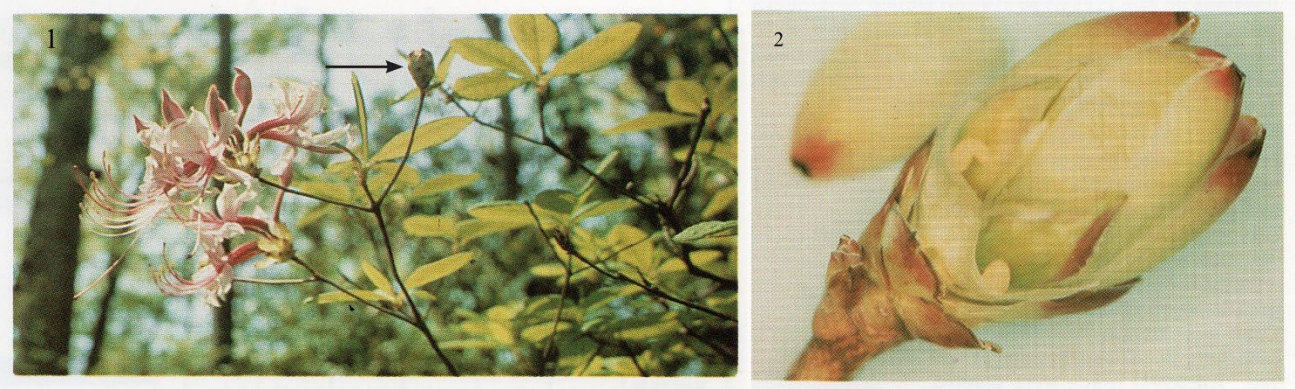

50. Enlarged flower buds, *Rhododendron periclymenoides*: *Dasineura praecox*. 1, Flowers and aborted flower bud (arrow); 2, active larvae in bud with scales removed.

See in Text.

51. Swollen berry, *Vaccinium stamineum*: *Dasineura* sp. Gagné 1989b.

See in Text.

52. Leaf roll, *Croton glandulosa*: *Lopesia* sp. Photo by M. Palmer.

See in Text.

53. Flower gall, *Euphorbia corollata*: *Schizomyia* sp. Photo by J. Steffen.

See in Text.

54. Flower galls. *Euphorbia* sp.: cecidomyiid. Photo by N. Taylor.

See in Text.

55. Petiole swelling, *Cercis canadensis*: *Contarinia* sp., *Dasineura* sp. Photo by R.J. Gagné.

See in Text.

56. Branch gall, *Dalea* sp.: cecidomyiid. Photo by M. Palmer.

See in Text.

57. Stem of *Glycine max*: *Resseliella maxima*. Gagné et al. 2019.

See in Text.

58. White mold gall midge on *Glycine max: Karshomyia caulicola*: a, larvae on mycelia on exterior of pods; b, inside stem; and c, inside pod. Koch et al. 2020.

See in Text.

59. Leaflet galls, *Mimosa aculeaticarpa*: cecidomyiid.

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60. Leaflet galls, *Olneya tesota*: *Contarinia* sp. Photo M. Plagens.

See in Text.

61. Aggregate bud gall, *Quercus virginiana*: *Arnoldiola atra*. Photo by L. Graney.

See in Text.

62. Twig gall, *Quercus* sp. (a red oak): *Polystepha* sp.: top, gall; bottom, details of larva. Photos by J. van der Linden.

See in Text.

63. Swollen petiole gall, *Quercus* sp. (a red oak): *Polystepha* sp. Photos by J. van der Linden.

See in Text.

64. Aborted flower and emergent pupa, *Fouquieria splendens*: *Asphondylia* sp. Photo by C.E. Eiseman.

See in Text.

65. Leaf blisters, *Ribes inerme*: *Ribesia sarae*. Photo by R.J. Gagné.

See in Text.

66. Swellings at base of stem, *Teucrium canadense*: *Neolasioptera* sp. Photo by M. Palmer.

See in Text.

67. Unopened, aborted flower, *Sphaeralcea angustifolia*: *Asphondylia* sp. Photo by C.E. Eiseman.

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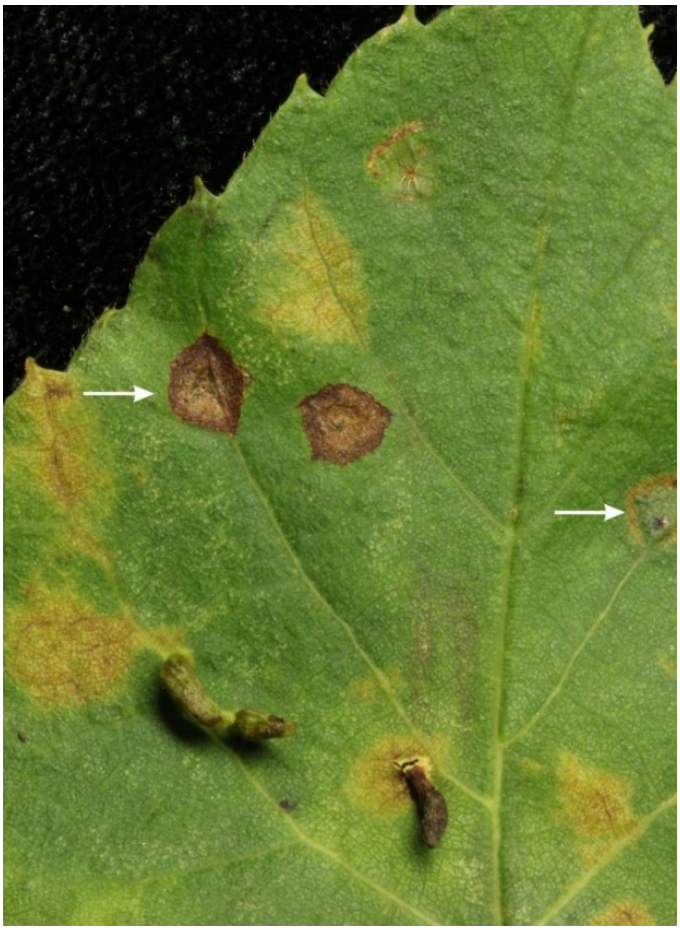

68. Leaf blister, *Tilia americana*: *Contarinia* sp. Photo by R.J. Gagné.

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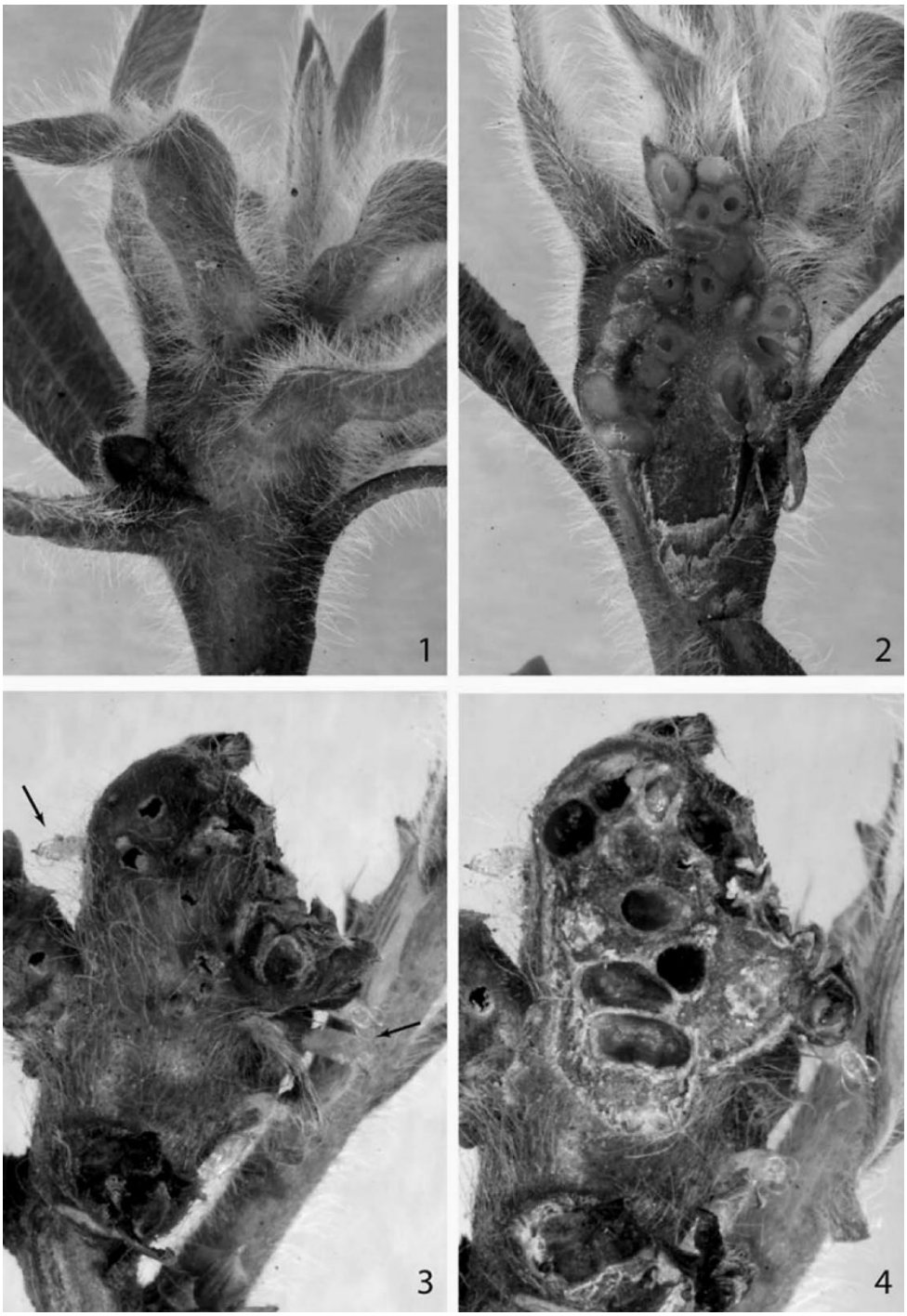
69. Vein swelling, *Tilia americana*: *Contarinia* sp. Photo by R.J. Gagné.

See in Text.

70. Leaf spots, *Claaytonia virginica*: *Dasineura* sp. Photo by R.J. Gagné.

See in Text.



71. Swollen shoots of paperbark, *Melaleuca quinquenervia*: *Lophodiplosis trifida*. 1, Galled young, soft shoot. 2, Longitudinal section of same, largely filled with spherical larval cells containing first instars. 3, Older, woody gall with exit holes, arrows indicating pupal exuviae still attached. 4, Same, longitudinal section, the topmost chamber with pupa still inside. Gagné et al. 2009.

See in Text.

72. Apical twig gall, *Forestiera pubescens*: *Contarinia* sp. Photo by J. C'deBaca.

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73. Midrib gall, *Fraxinus pennsylvanica*: *Dasineura tumidosae*: 1-2, galls; 3, gall forced open to show gregarious larvae. Gagné 1989b.

See in Text.

74. Flower galls, *Epilobium latifolium*: *Dasineura* epilobii. Photo by A.Wenninger.

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75. Bud gall, *Epilobium canum*: cecidomyiid. Photo by J. Gross.

See in Text.

76. Swollen shoots, *Picea abies*: *Piceacecis abietiperda*. 1, Old shoot galls from previous year following adult emergence. 2, Tissue cut away to show fresh galls, May. 3, Same, first instars in individual chambers. 4, Tissue removed to show full-grown larvae (prepupal third instars), February. 5, Exerted pupal exuviae, April. 6, Newly emerged female, April. Gagné & Graney 2014.

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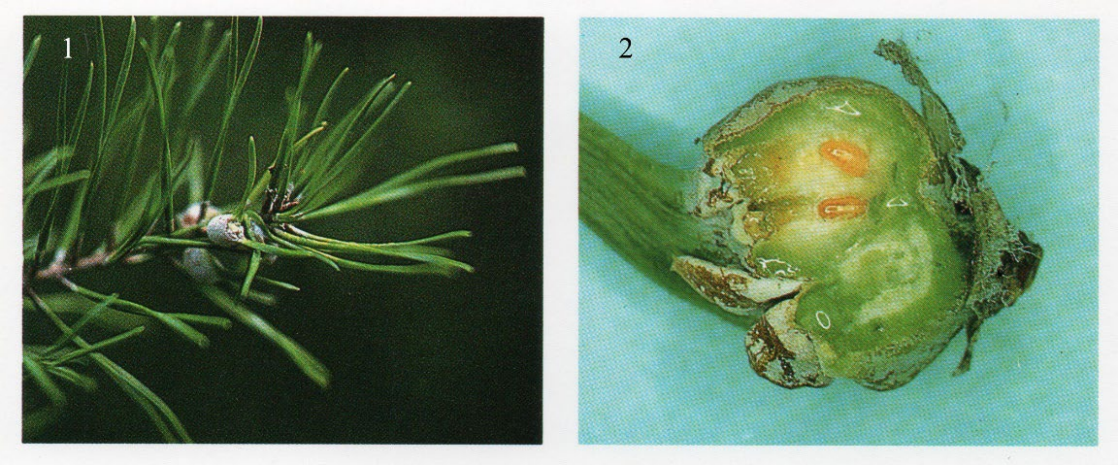
77. Foreshortened branchlet, *Pinus edulis*: possibly *Cembrotia* sp. Photo by R. Sullivan.

See in Text.

78. Section through foreshortened branchlet, *Pinus edulis*: poss. *Cembrotia* sp. Photo by R. Sullivan.

See in Text.



79. Needle gall, *Pinus virginiana*: *Thecodiplosis brachynteroides*. 1, Galls; 2, section through gall. R.J. Gagné 1989b.

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80. Stem galls, *Arctagrostis latifolia*: *Mayetiola* sp. Photo by D. Collet.

See in Text.

81. Spikelet galls, *Muhlenbergia cuspidate*: cecidomyiid. Photo by P. Johnson.

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82. Stunted tillers, *Zea mays*: *Chilophaga tripsaci*. 1, Field of maize in Michoacán, Mexico, at time of infestation by C. tripsaci. 2, Stunted and discolored maize tillers. 3, Larvae of C. tripsaci in maize. 4, Same, mature larvae. Gagné & Figueroa 2022.

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83. Stem swelling, *Portulaca oleracea*: *Neolasioptera portulacae*. Photo by C. Gourmel.

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84. Apical bud galls, *Lysimachia* sp.: *Asphondylia* sp. Photo by N. Dorchin.

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85. Enlarged flower bud, *Ceanothus* sp.: *Asphondylia* sp. 1, Gall; 2, Gall sectioned, showing larva. Photos by J. Gross.

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86. Entire leaf folded, *Ceanothus verrucosus*: *Contarinia* sp. Photo by M. Claire.

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87. Pedicellate, aborted flowers, *Rhamnus crocea*; *Asphondylia* sp. Photo by M. Claire.

See in Text.

88. Tightly closed flower bud *Adenostoma fasciculatum*: *Bruggmanniella adenostoma*. Photo by J. Gross.

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89. Vein swelling, *Cercocarpus montanus*: cecidomyiid. Photo by C.E. Eiseman.

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90. Petiole swelling, *Fragaria virginiana*: cecidomyiid. Photo by C.E. Eiseman.

See in Text.

91. Swollen flowers, *Physocarpus opulifolius*: *Contarinia* sp. Photo by R.J. Gagné.

See in Text.

92. Petiole swelling. *Potentilla canadensis*: *Neolasioptera potentillaecaulis*. Photo by C.E. Eiseman.

See in Text.

93. Scabrous stem swellings. *Prunus* sp.: cecidomyiid. Photo by M. Frechette.

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94. Midrib swelling, *Prunus mexicana*: *Parallelodiplosis* sp. Photo by M. Palmer.

See in Text.

95. Starburst gall, *Spiraea alba*: *Cecidomyia lappa*. Photo by G. DeWolf.

See in Text.

96. Smooth axial gall, *Spiraea alba*: *Hormomyia clarkei*. Photo by C.E. Eiseman.

See in Text.

97. Smooth axial gall with reflexed bracts, *Spiraea alba*: possibly *Hormomyia clarkei*. Photo by R. Russo.

See in Text.

98. Single leafy rosette, *Spiraea alba*: cecidomyiid. Photo by G. DeWolf.

See in Text.

99. Swollen midrib, *Spiraea alba*: *Dasineura salicifoliae*. Photo by R.J. Gagné.

See in Text.

100. Enlarged flower buds, *Galium maritimum*: *Resseliella* sp. Photo by J. Bailey.

See in Text.

101. Flower bud galls, *Spermacoce neoterminalis*: *Asphondylia* sp. possibly *borreriae*. Photo by K.L. Hibbard.

See in Text.

102. Smooth pouch galls, *A. saccharum*: *Dasineura* sp. Photo by R.J. Gagné.

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103. Short, corrugated pouch gall, *A. saccharum*: *Dasineura* sp. Photo by R.J. Gagné.

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104. Spheroid leaf galls, *Sideroxylon celastrinum*: cecidomyiid. Photo by J. Brushwein.

See in Text.

105. Hemispherical galls, *C. annuum*: *Clinodiplosis capsicum*. Gagné et al. 2000.

See in Text.

106. Stem swelling, *Solanum carolinense*: *Lasioptera solani*. Photo by R.J. Gagné.

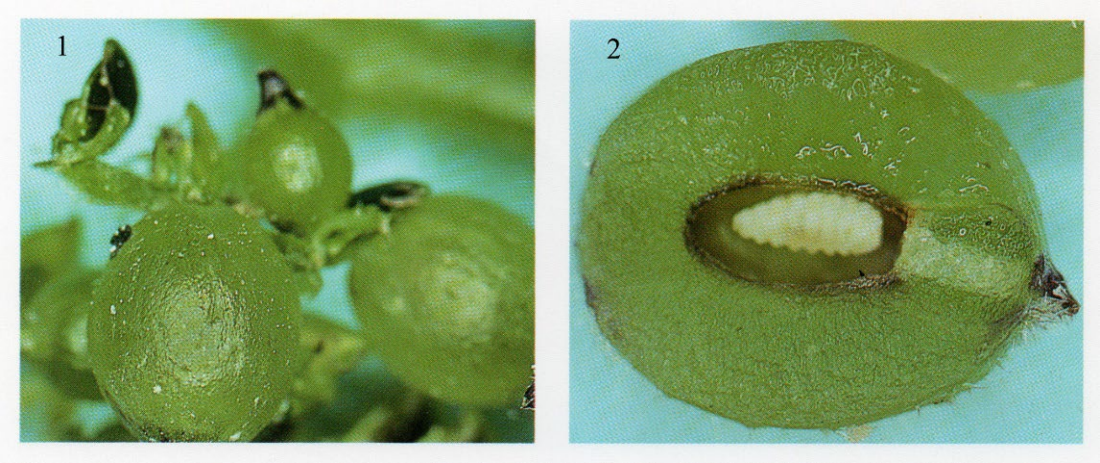
See in Text.

107. Leaf spot, larva exiting, *Ulmus rubra*: *Dasineura* sp. Photo by R.J. Gagné.

See in Text.

108. Samara gall, *Ulmus americana*: *Primavera porrecta*. 1, Eggs at base of flower bud; 2, First instar crawling on developing samara; 3, Third instar in pocket of malformed samara. Gagné 1989b.

See in Text.



109. Ovoid galls, *Laportea canadensis*: *Dasineura investita*. 1, Galls; 2, Gall in section with larva in chamber. Gagné 1989b.

See in Text.

110. Apical stem gall, *Glandularia bipinnatifida*: *Neolasioptera* sp. Photo by R. Russo.

See in Text.

111. Modified tendrils, *Parthenocissus quinquefolia: Neolasioptera psederae*. Photo by Bill Sheehan.

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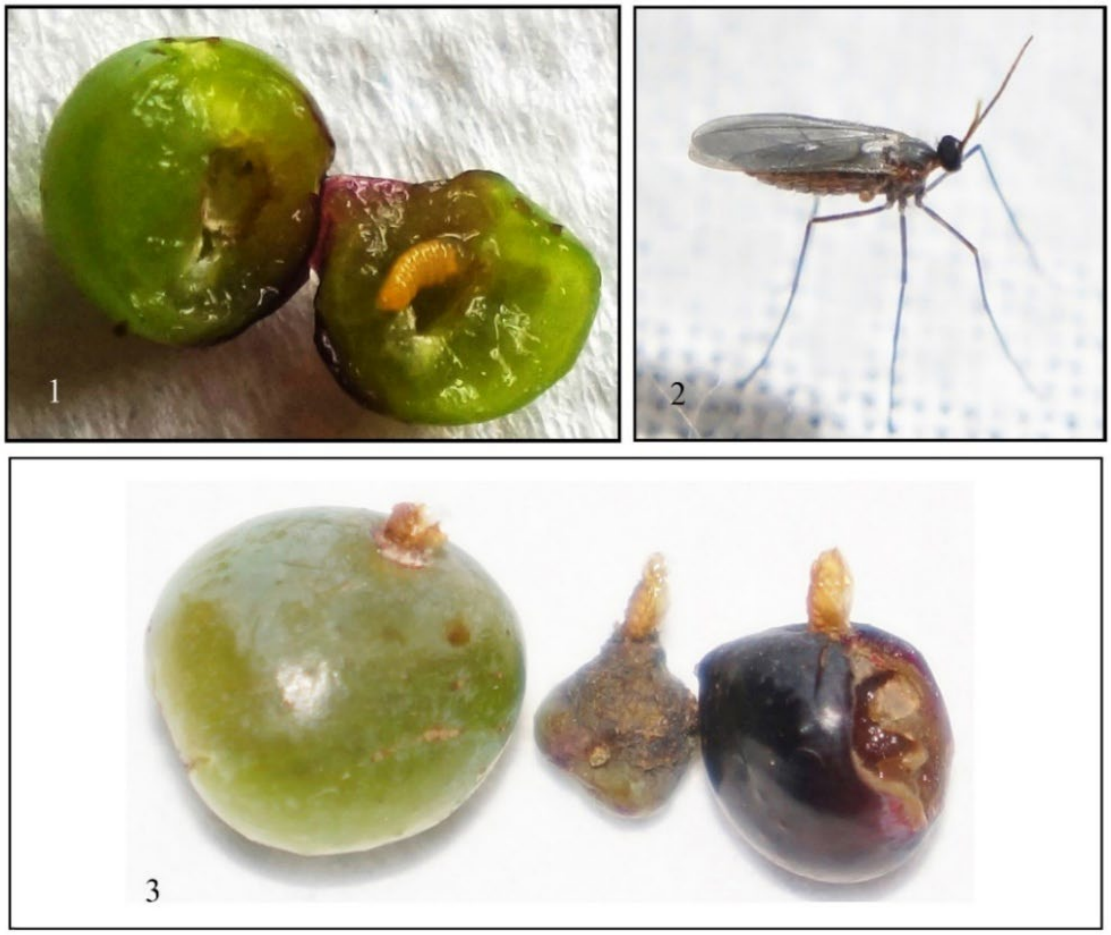
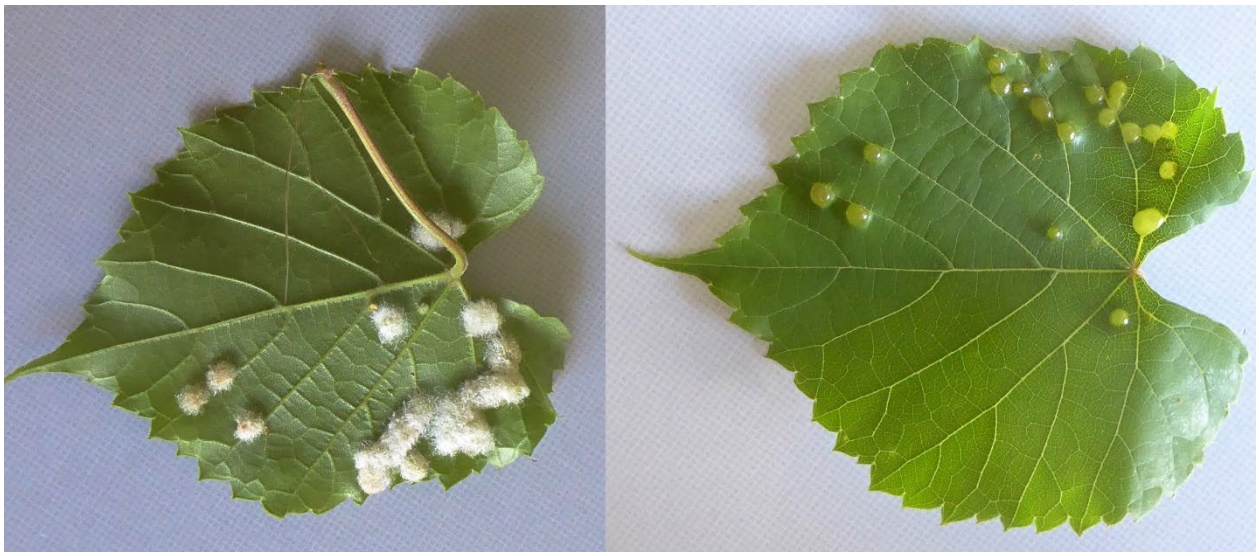


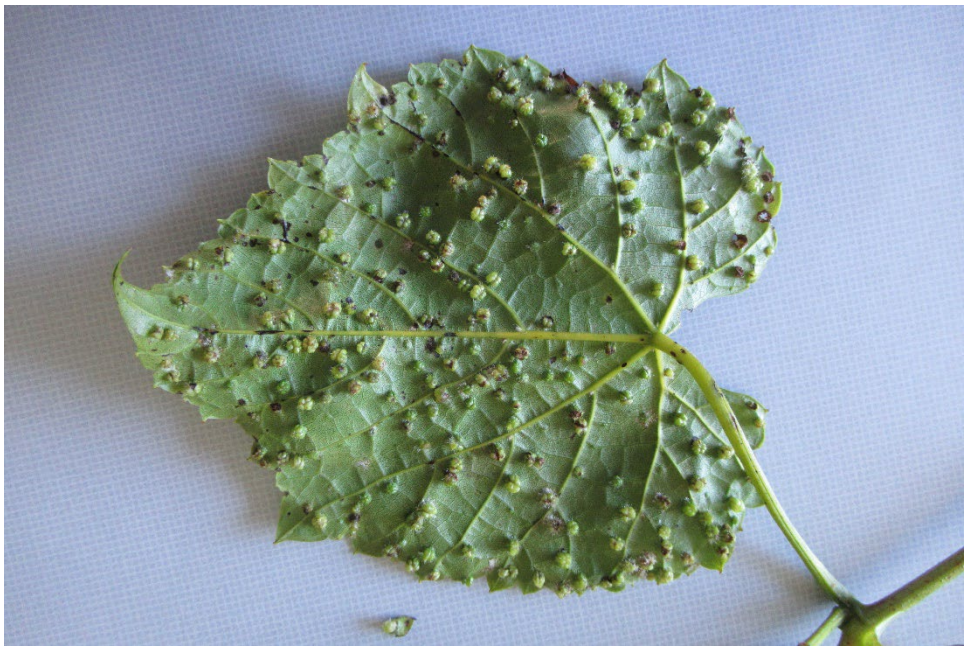
112. Swollen fruit, *Vitis* sp.: *Asphondylia uvarum*. 1, Larva in berry; 2, Female; 3, Damaged berries with pupal exuviae. Gagné et al. 2018.

See in Text.



113. Leaf galls, *Vitis rotundifolia*: *Vitisiella* sp.; on left, underside of leaf; on right, upper side. Photos by R.J. Gagné.

See in Text.



114. Leaf galls, underside of leaf, *Vitis rotundifolia*: *Daktulosphaira vitifoliae* (Hemiptera: Phylloxeridae). Photo by R.J. Gagné.

See in Text.

PLATES

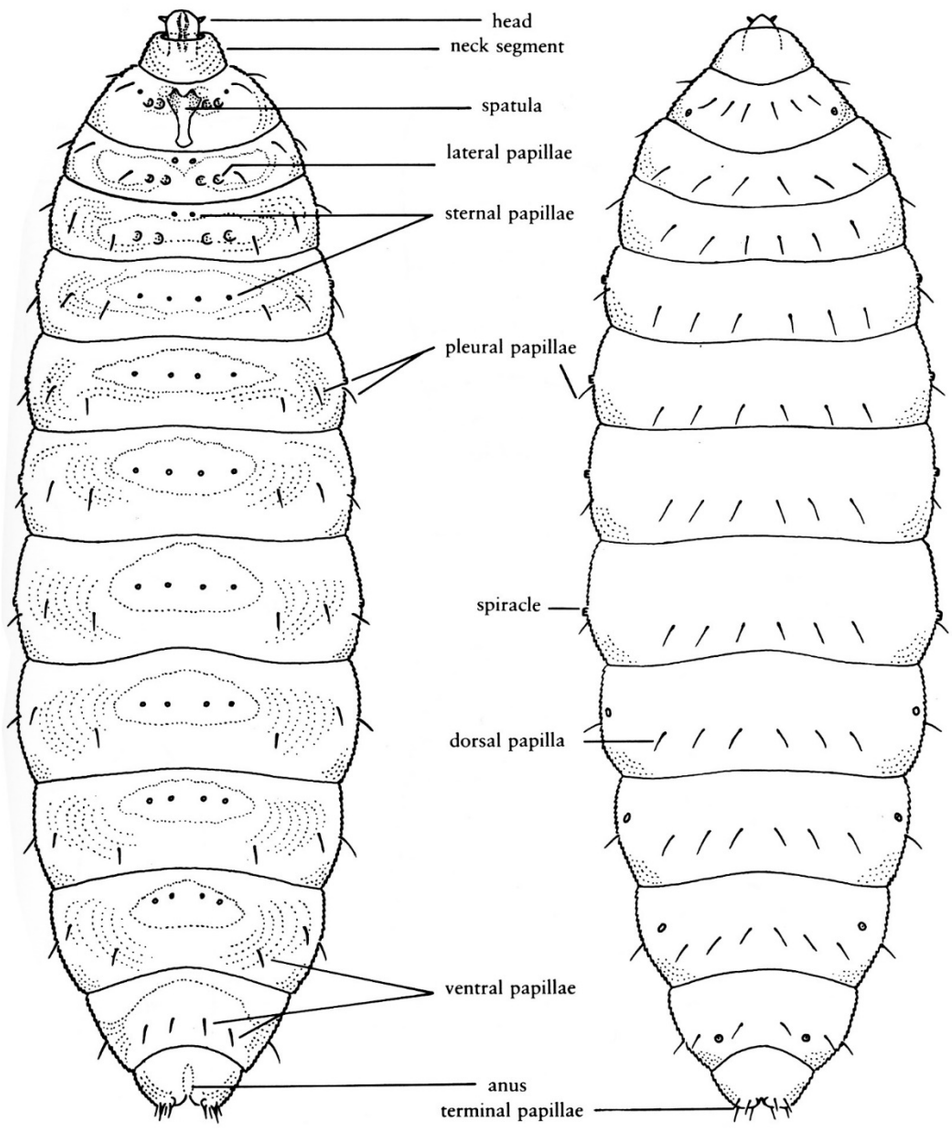


Plate 1. *Dasineura gleditchiae* larva, 50x. Ventral view on left, dorsal on right. Gagné 1989.

To 1 Introduction.
To 2 Anatomy.
To 3 Biology.
To 4 Synopsis.
To 6 Plant Galls.
To 7 Collecting, Rearing and Preparing Gall Midges.

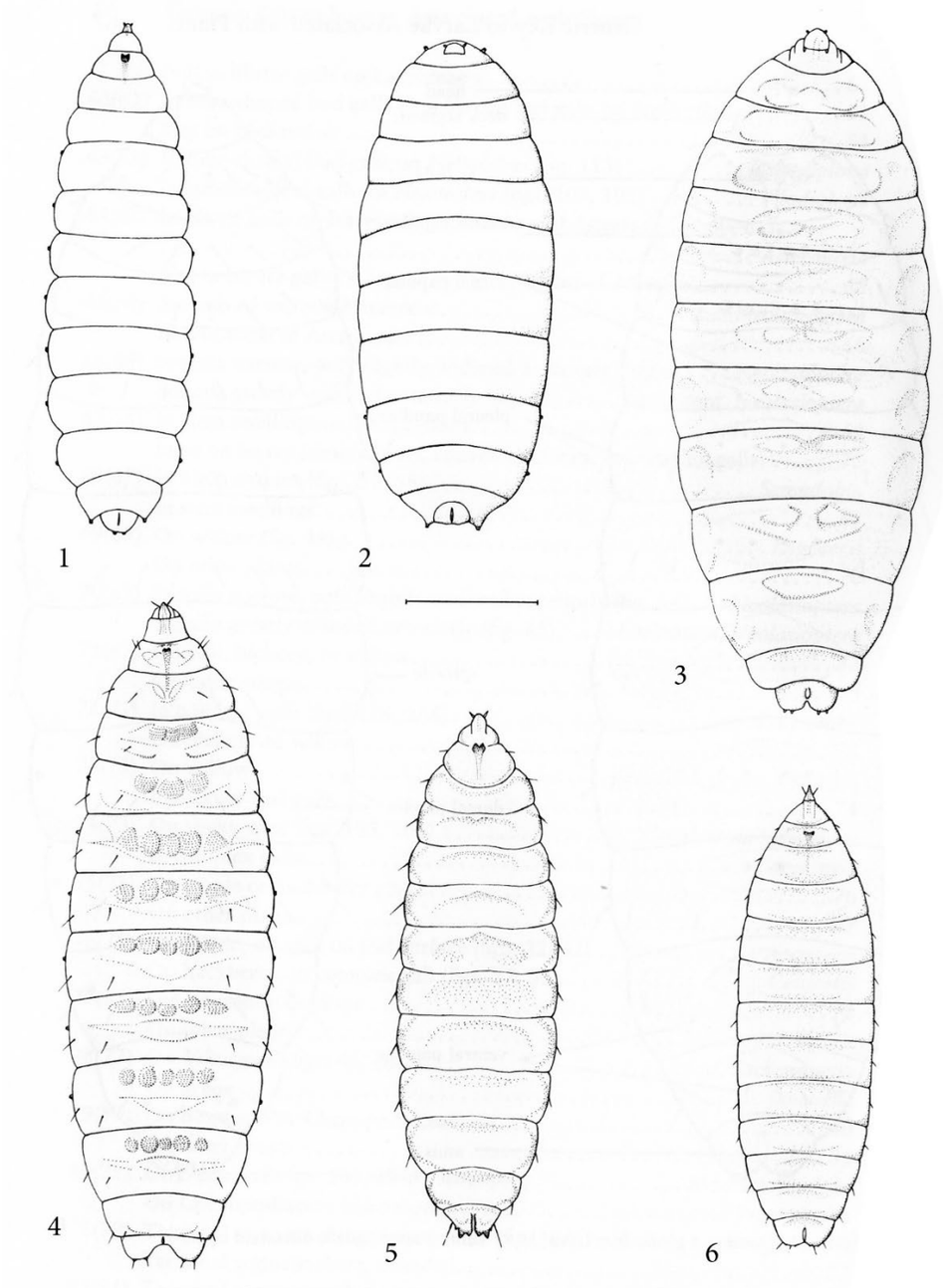


Plate 2. Larvae, ventral view. **1,** *Contarinia schulzi*. **2,** *Stenodiplosis wattsi*. **3,** *Acericecis ocellaris*. **4,** *Aphidoletes urticariae*. **5,** *Clinodiplosis* sp. **6,** *Mycodiplosis thoracica*. Scale line = 0.5 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

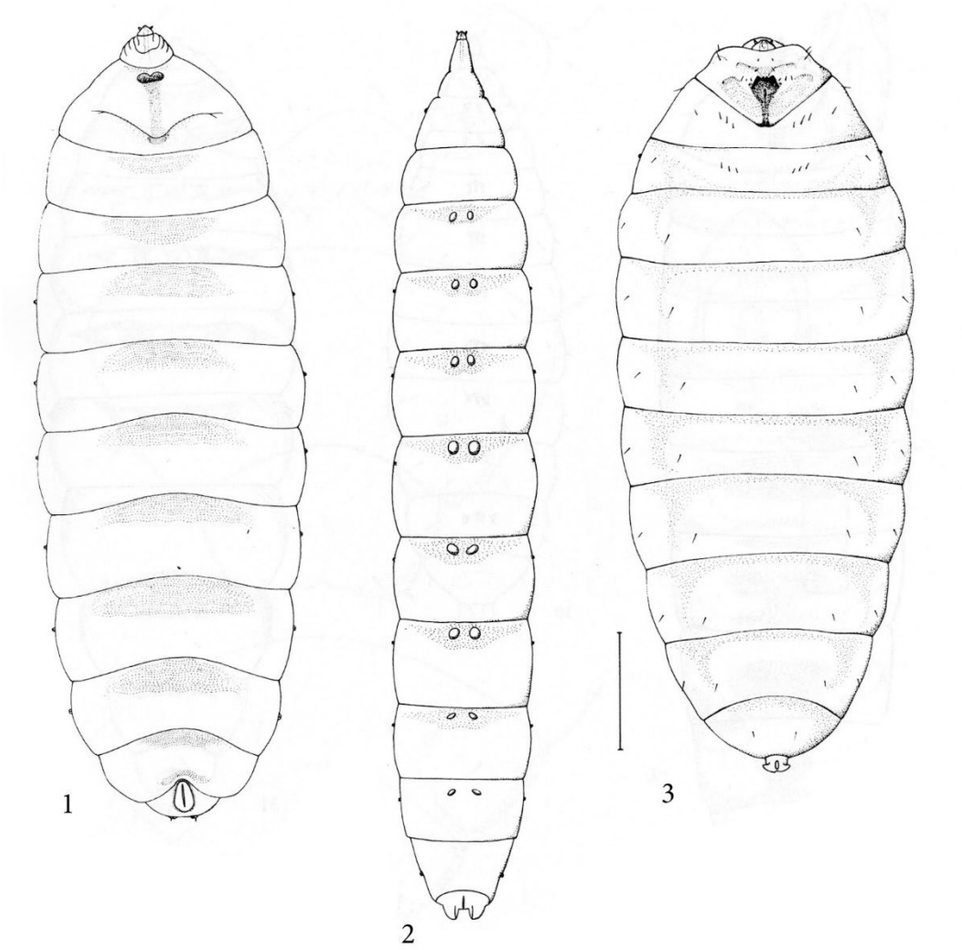


Plate 3. Larvae, ventral view. **1,** *Contarinia pyrivora*. **2,** *Asynapta hopkinsi*. **3,** *Asphondylia atriplicis*. Scale line = 0.5 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.
To 8 Gall Keys (Pinaceae).

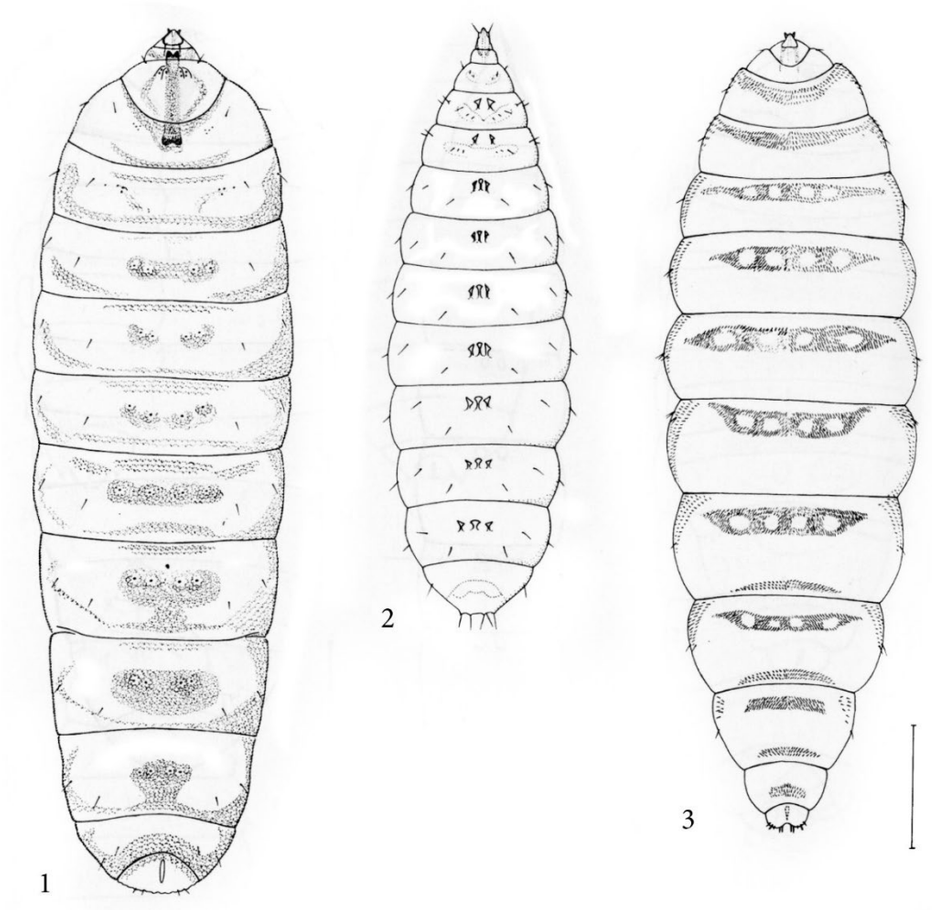


Plate 4. Larvae, ventral view. **1,** *Neolasioptera fontagrensis*. **2,** *Lestodiplosis* sp. **3,** *Cecidomyia resinicola*. Scale line = 0.5 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

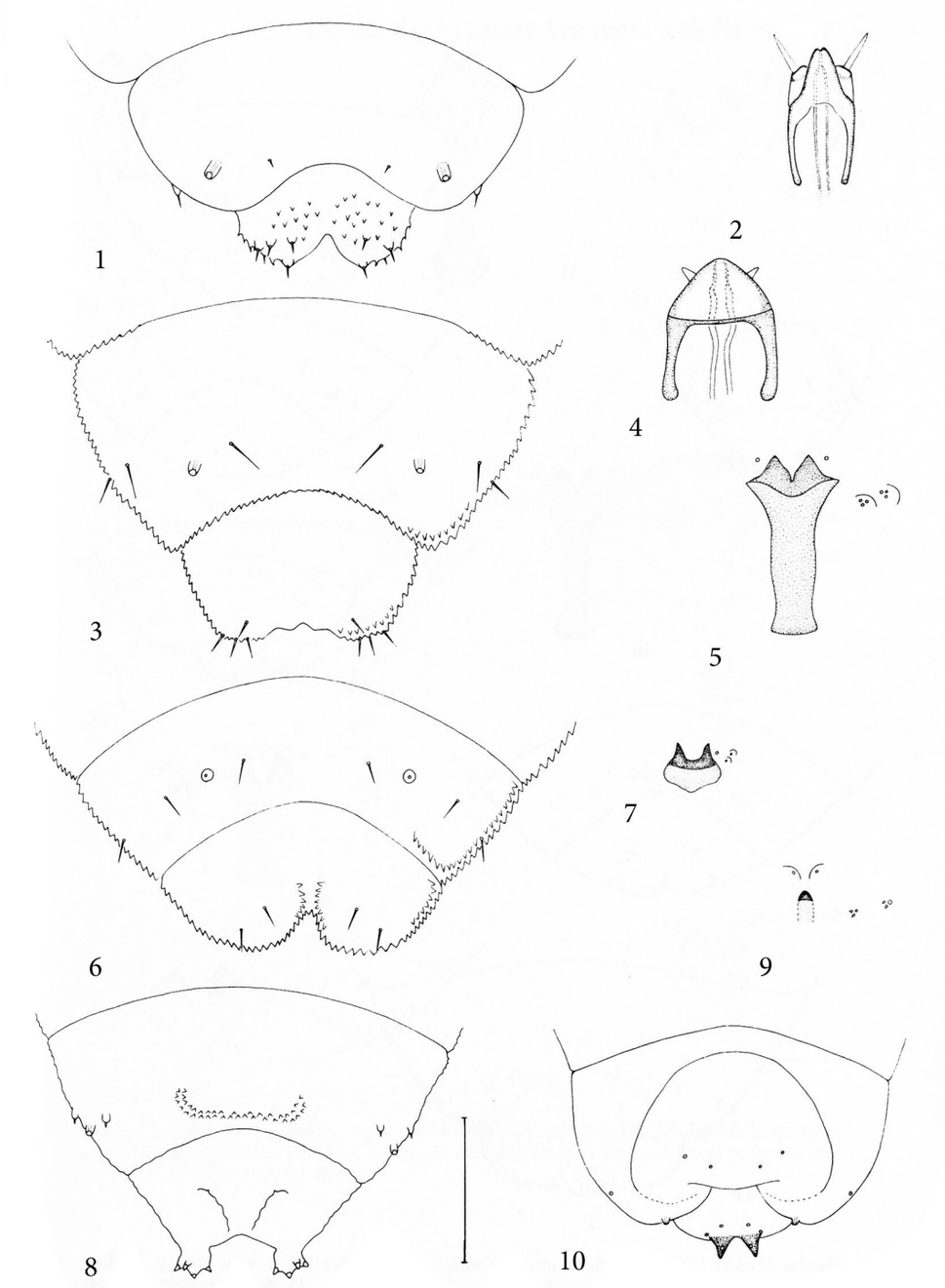
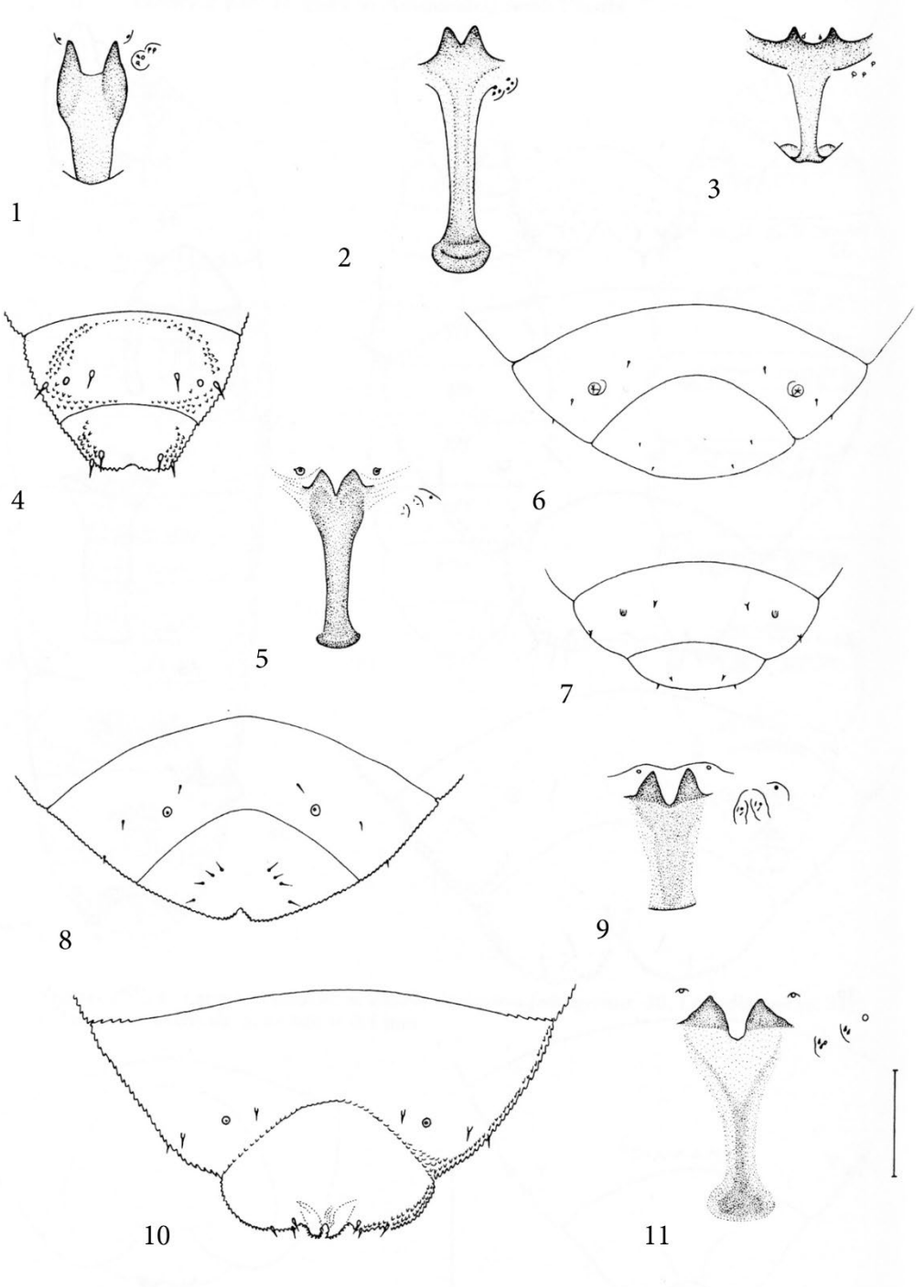


Plate 5. Larval posterior segments (dorsal), heads, and spatulae with associated papillae. **1,** *Acericecis ocellaris*. **2,** *Lestodiplosis* sp. **3-5,** *Dasineura gleditchiae*. **6-7,** *Celticecis* sp. **8,** *Procystiphora gerardii*. **9-10,** *Camptomyia pseudotsugae*. Scale line = 0.2 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.



P**late 6.** Larval posterior segments (dorsal) and spatulae with associated papillae. **1,** *Rabdophaga* sp. **2,** *Rabdophaga* sp. **3,** *Lygocecis* sp. **4-5,** *Sackenomyia* sp. **6,** *Walshomyia cupressi*. **7,** *Cembrotia coloradensis*. **8-9,** *Cupressatia siskiyou*. **10-11,** *Craneiobia tuba*. Scale line = 0.2 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

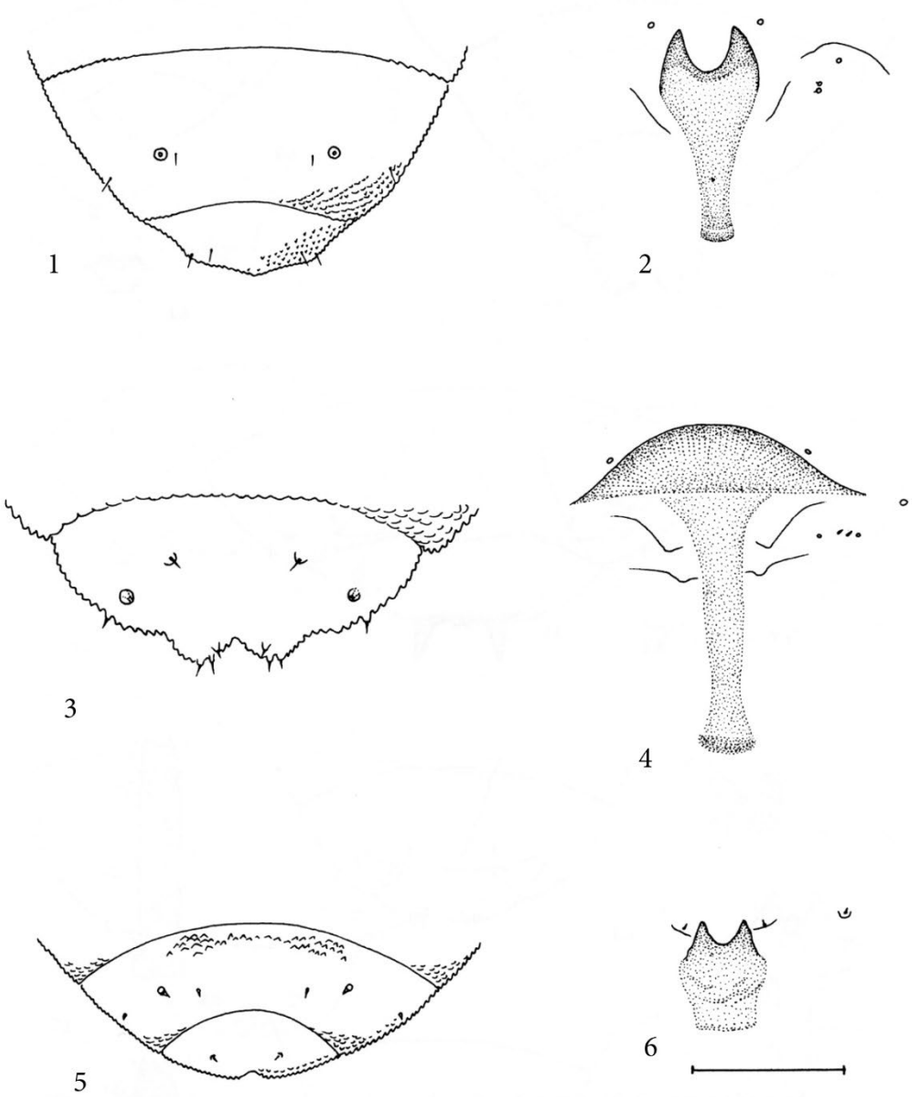


Plate 7. Larval posterior segments (dorsal) and spatulae with associated papillae. **1-2,** *Vitisiella* sp. from grape. **3-4,** *Primavera porrecta*. **5-6,** *Semudobia tarda*. Scale line: larval posterior segments, 0.2 mm; spatulae, 0.1 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

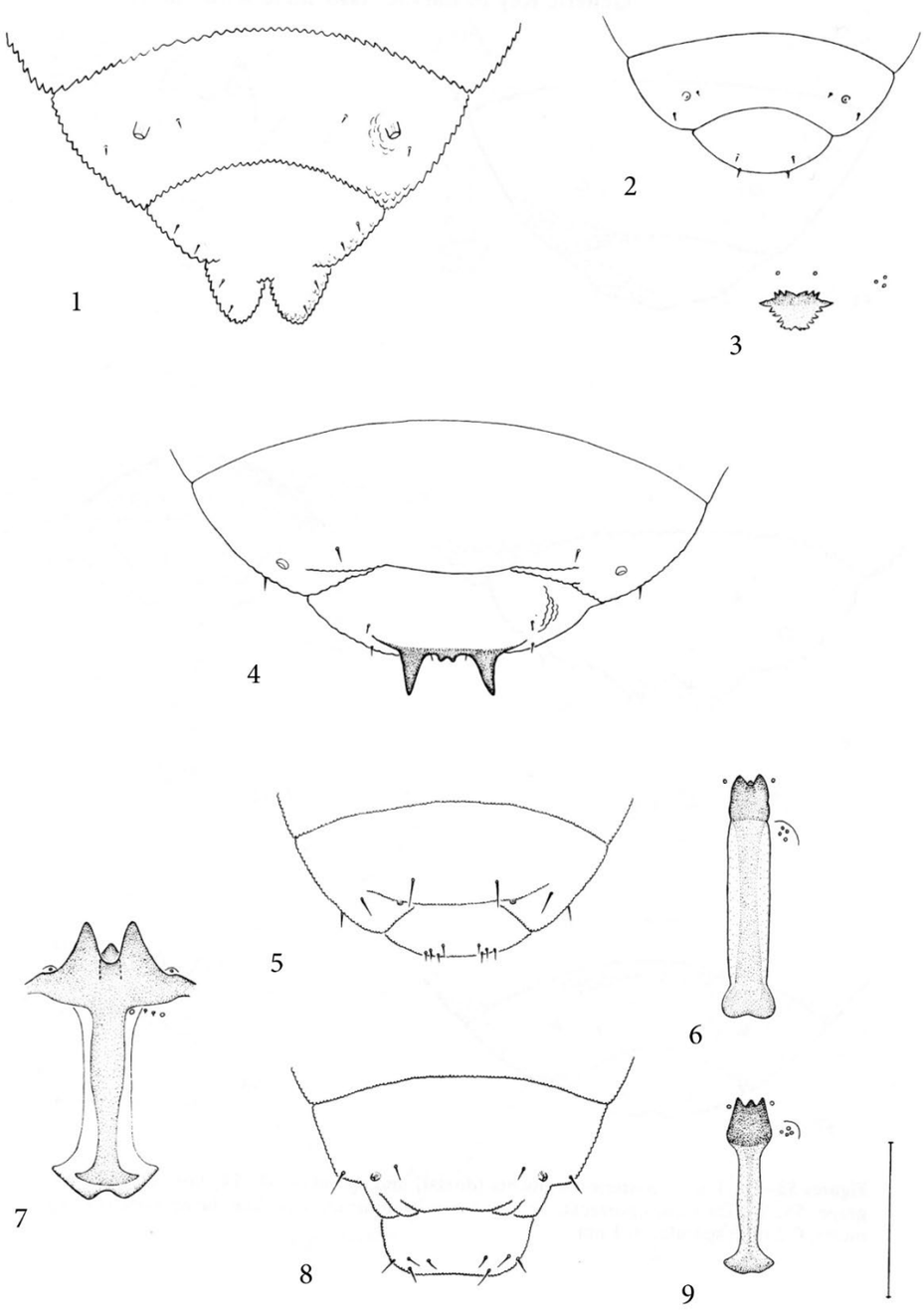


Plate 8. Larval posterior segments (dorsal) and spatulae with associated papillae. **1,** *Chilophaga gyrantis*. **2-3,** *Asteromyia carbonifera*. **4,** *Edestochilus allioides*. **5-6,** *Neolasioptera fontagrensis*. **7,** *Lasioptera* sp. **8-9,** *Calamomyia alterniflorae*. Scale line = 0.2 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.
To 8 Gall Keys (Poaceae).

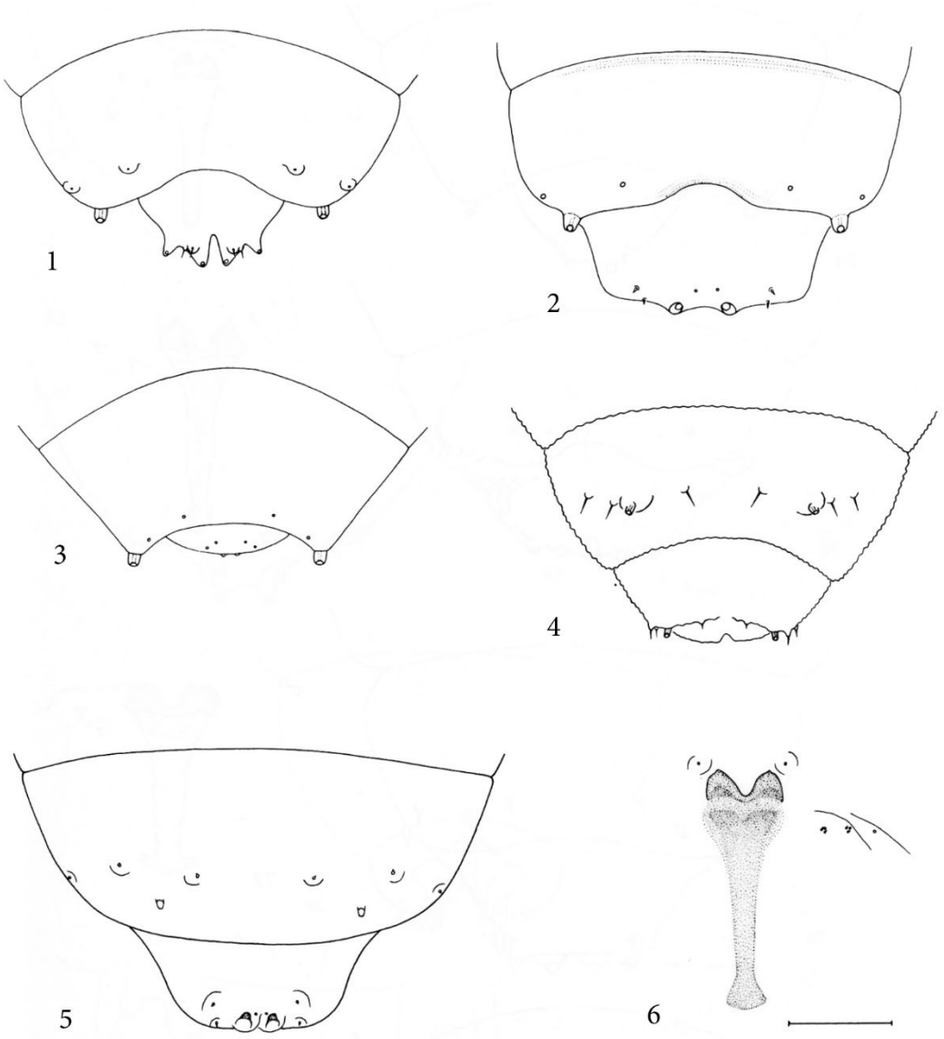


Plate 9. Larval posterior segments (dorsal) and spatula with associated papillae. **1,** *Contarinia baeri*. **2,** *Contarinia acuta*. **3,** *Stenodiplosis wattsi*. **4,** *Contarinia* sp. on spirea. **5-6,** *Contarinia* oregonensis. Scale line = 0.2 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

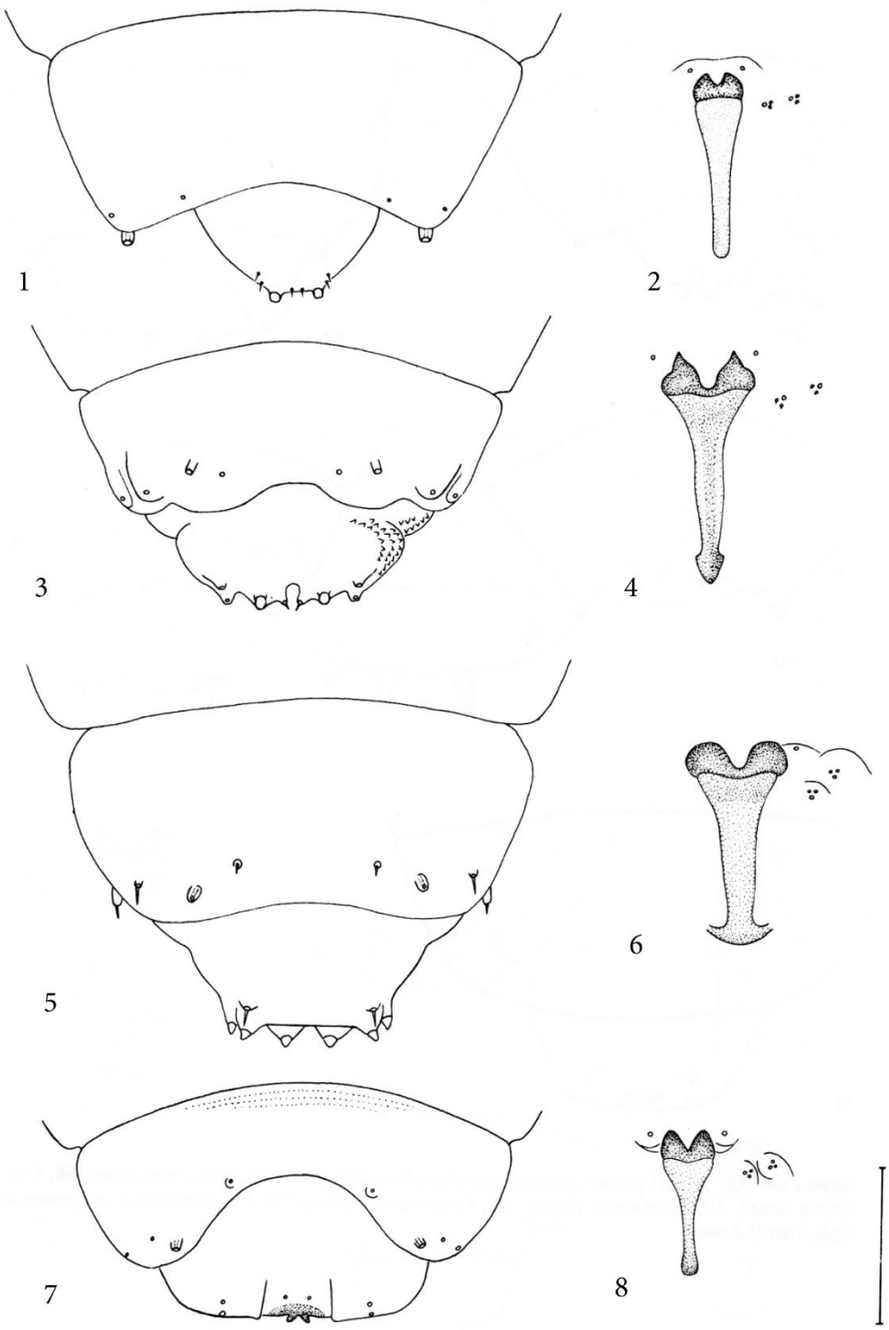


Plate 10. Larval posterior segments (dorsal) and spatulae. **1-2,** *Contarinia* sp. nr. *schulzi* from *Baccharis*. 3-4**,** *Harmandiola nucicola*. **5-6,** *Putoniella* sp. **7-8,** *Thecodiplosis brachynteroides*. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

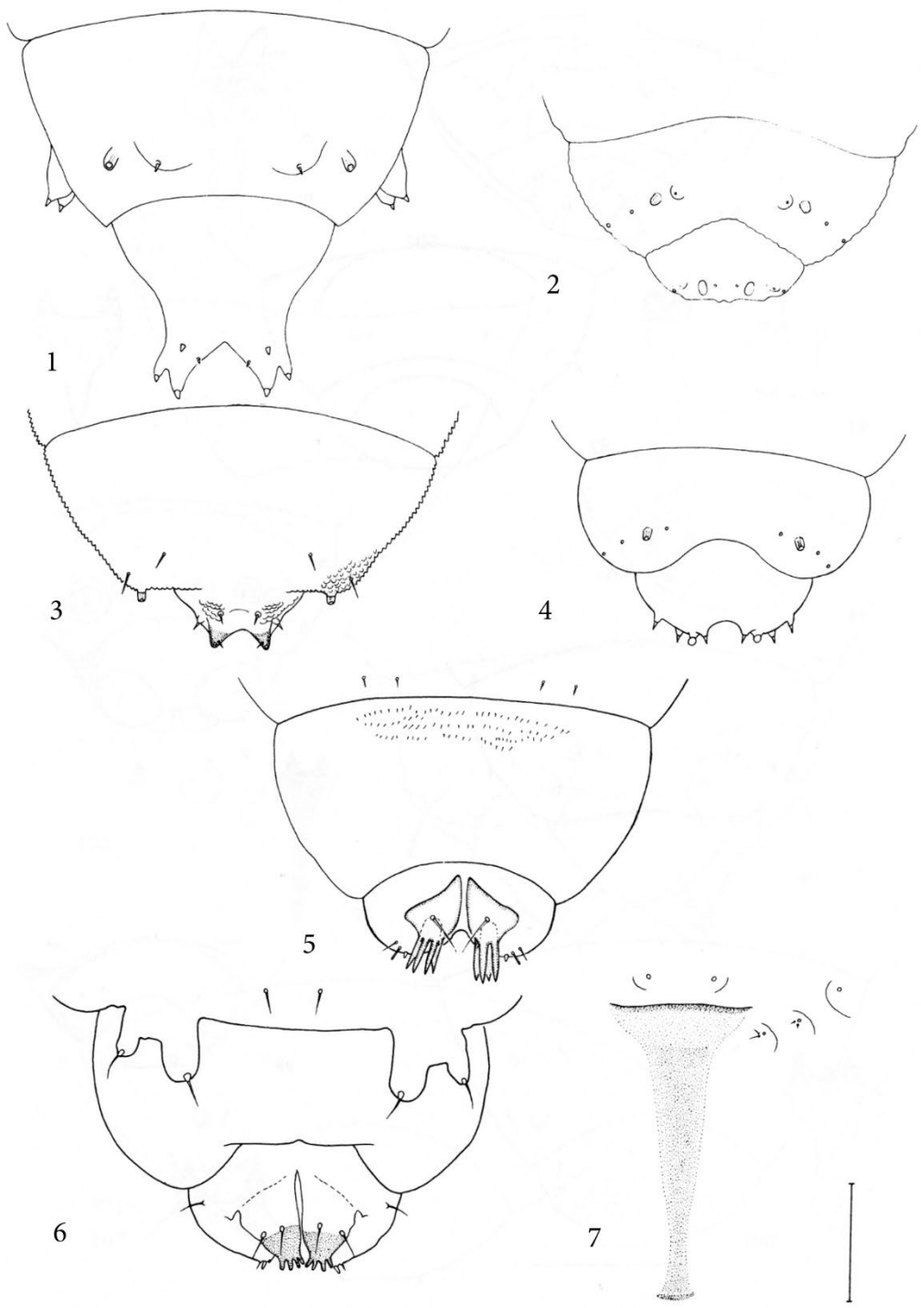


Plate 11. Larval posterior segments (dorsal) and spatula with associated papillae. **1,** *Zeuxidiplosis giardi*. **2,** *Paradiplosis tumifex*. **3,** *Resseliella conicola*. **4,** *Harmandia* sp. **5,** *Cecidomyia resinicola*. **6-7,** *Cecidomyia candidipes*. Scale line = 0.2 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.
To 8 Gall Keys (Pinaceae).

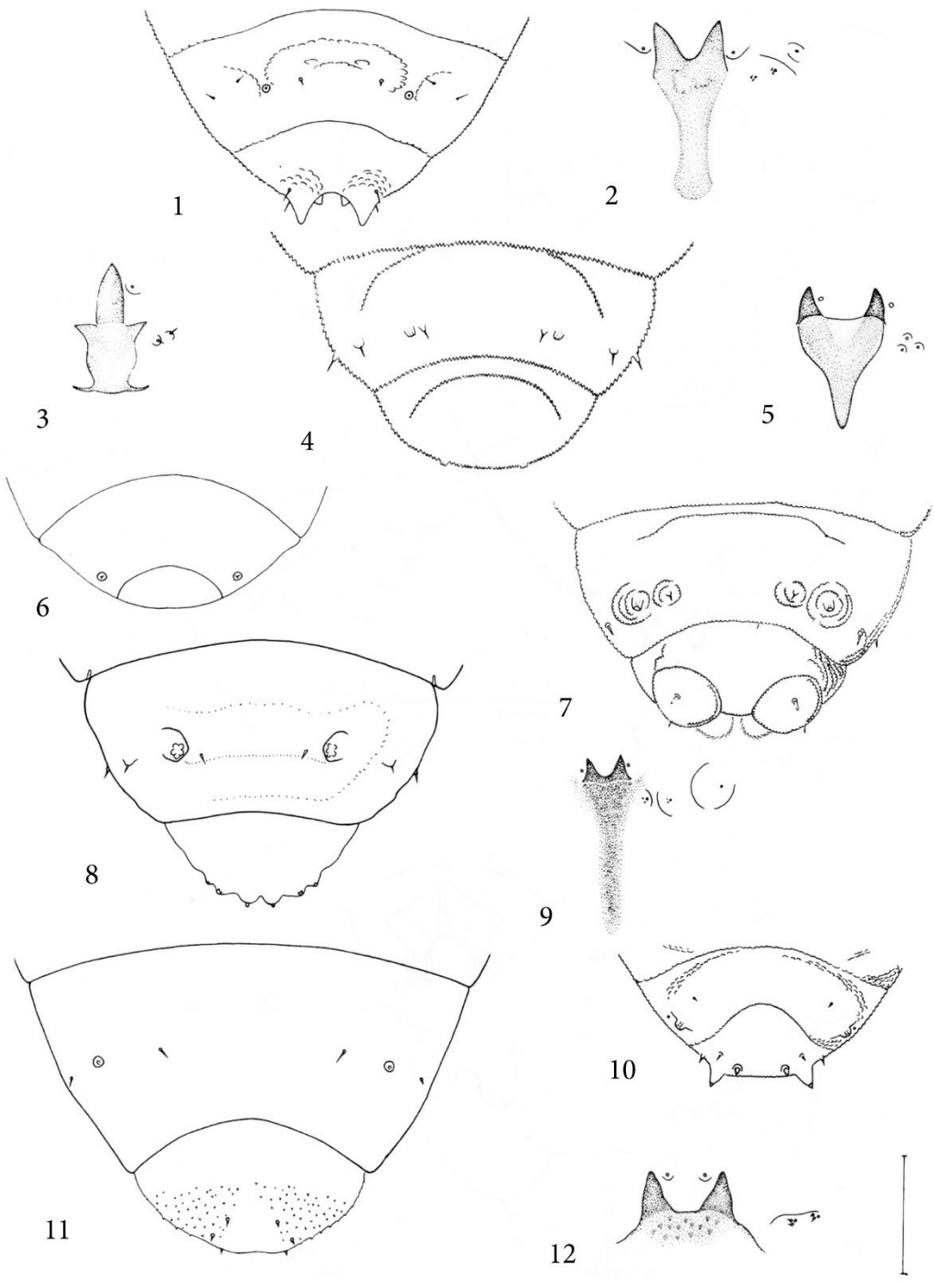


Plate 12. Larval posterior segments (dorsal) and spatulae with associated papillae. **1-2,** Cecidomyiid on *Andropogon gerardii*. **3-4,** *Caryomyia leviglobus*. **5,** *Caryomyia* sp. **6,** *Pinyonia edulicola*. **7,** *Obolodiplosis robiniae*. **8-9,** *Ctenodactylomyia watsoni*. **10,** Cecidomyiid on *Bouteloua curtipendula*. **11-12,** *Planetella* sp. Scale line = 0.2 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.
To 8 Gall Keys (Poaceae).

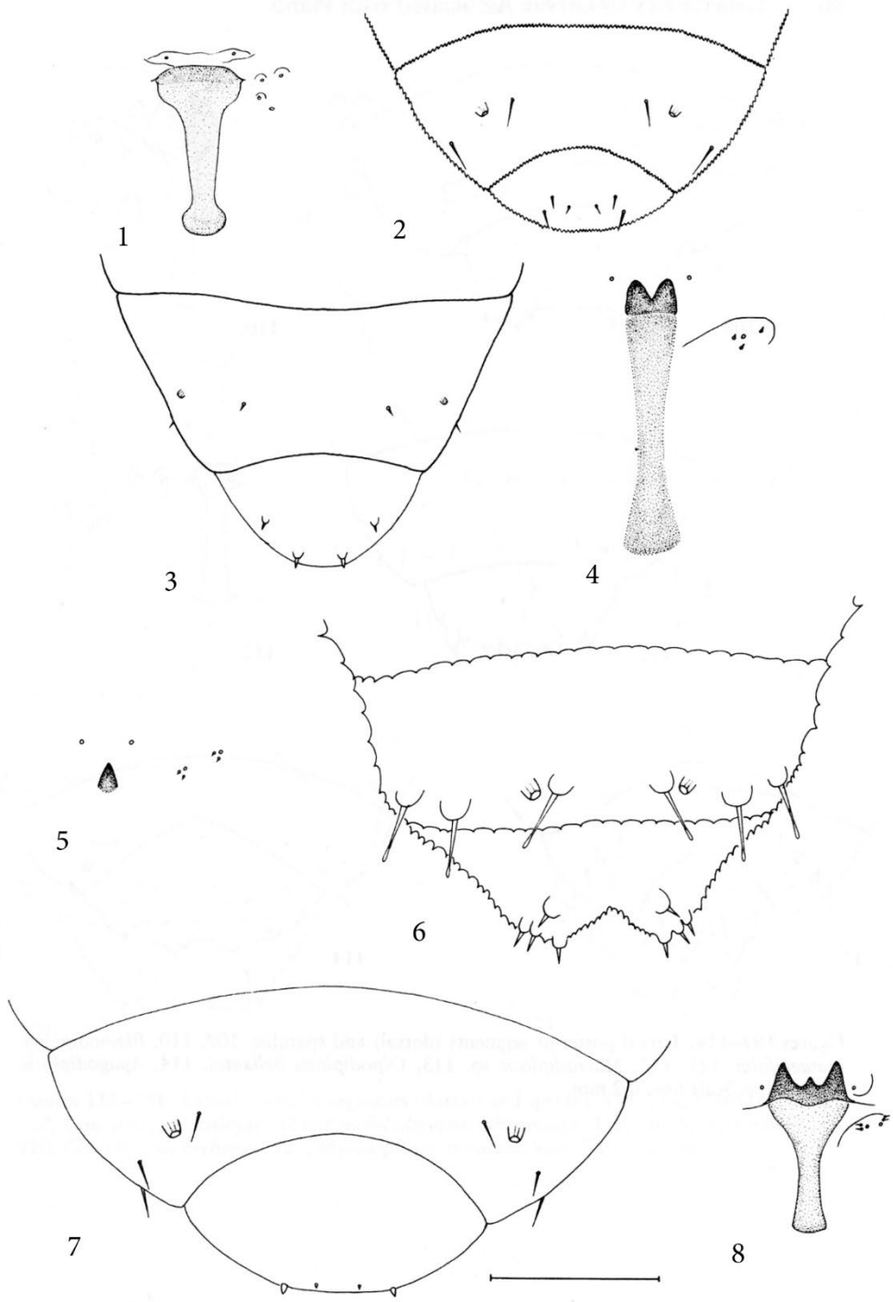


Plate 13. Larval posterior segments (dorsal) and spatulae with associated papillae. **1-2,** *Pilodiplosis helianthibulla*. **3-4,** *Monarthropalpus flavus*. **5-6,** *Gliaspilota glutinosa*. **7-8,** *Taxodiomyia sp*. Scale line = 0.2 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

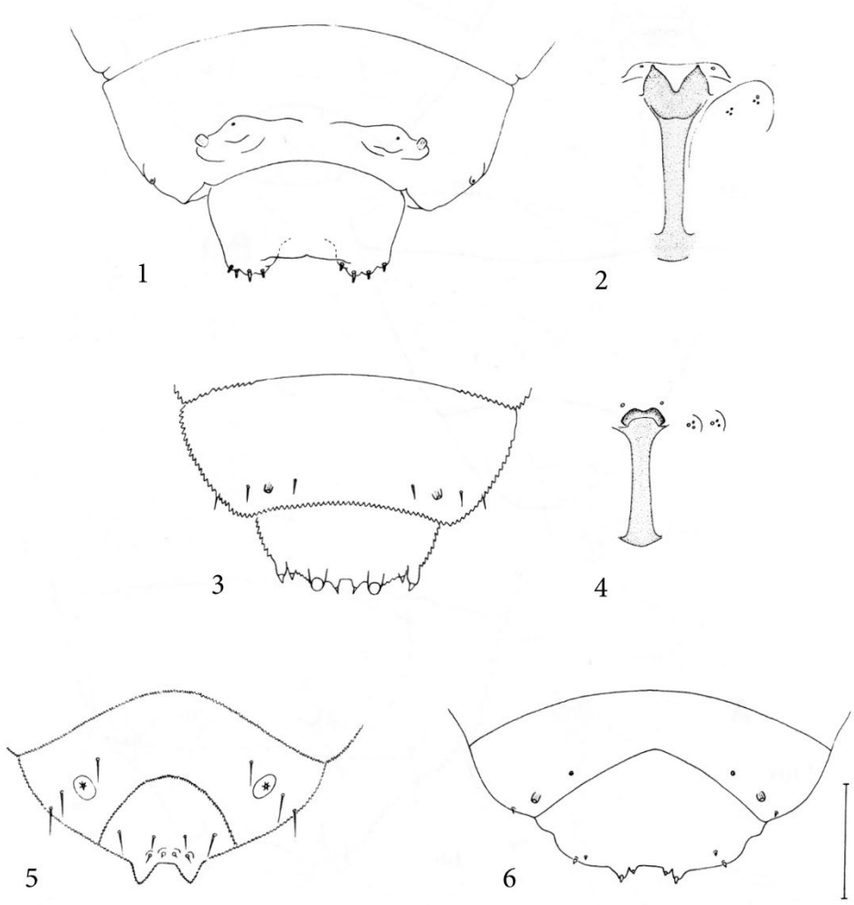


Plate 14. Larval posterior segments (dorsal) and spatulae with associated papillae. **1-2,** *Blaesodiplosis crataegifolia*. **3-4,** *Macrodiplosis* sp. **5,** *Olpodiplosis helianthi*. **6,** *Massalongia papyriferae*. Scale line = 0.2 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

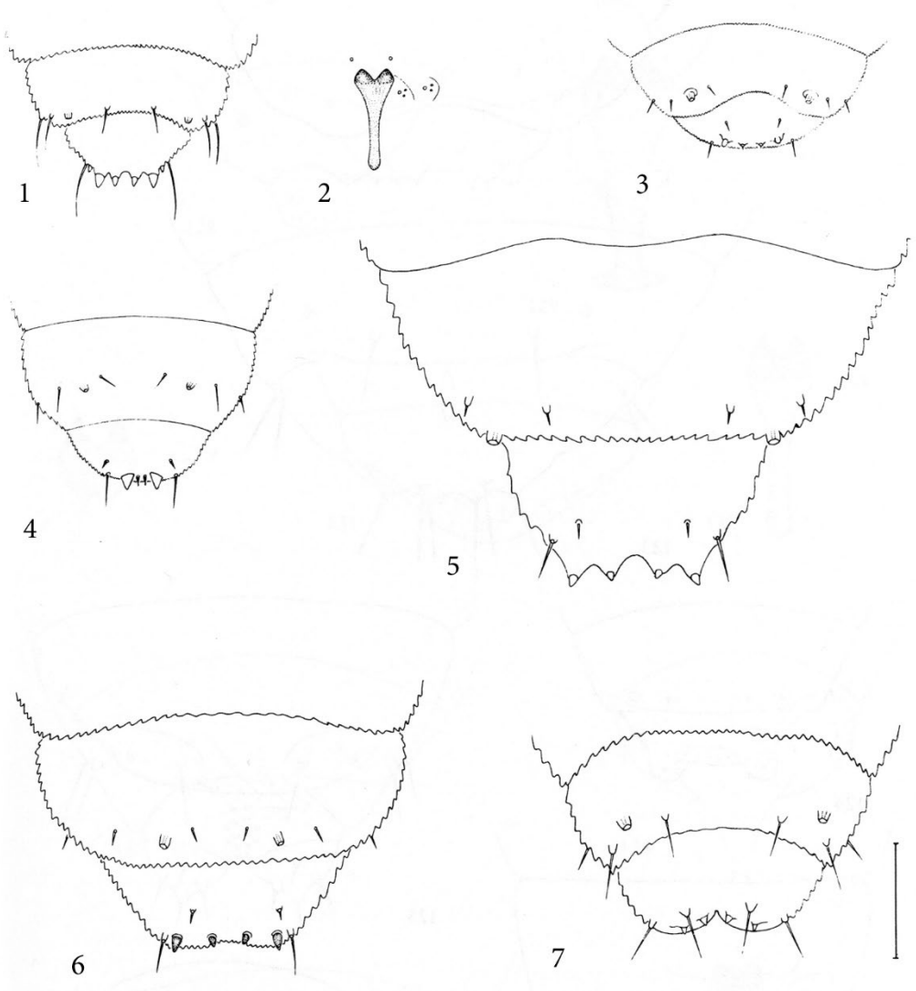


Plate 15. Larval posterior segments (dorsal) and spatula with associated papillae. **1-2,** *Clinodiplosis sp.* **3,** *Clinodiplosis cattleyae*. **4,** *Parallelodiplosis subtruncata*. **5,** *Sitodiplosis mosellana*. **6,** *Clinodiplosis verbenae*. **7,** *Mycodiplosis thoracica*. Scale line = 0.2 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

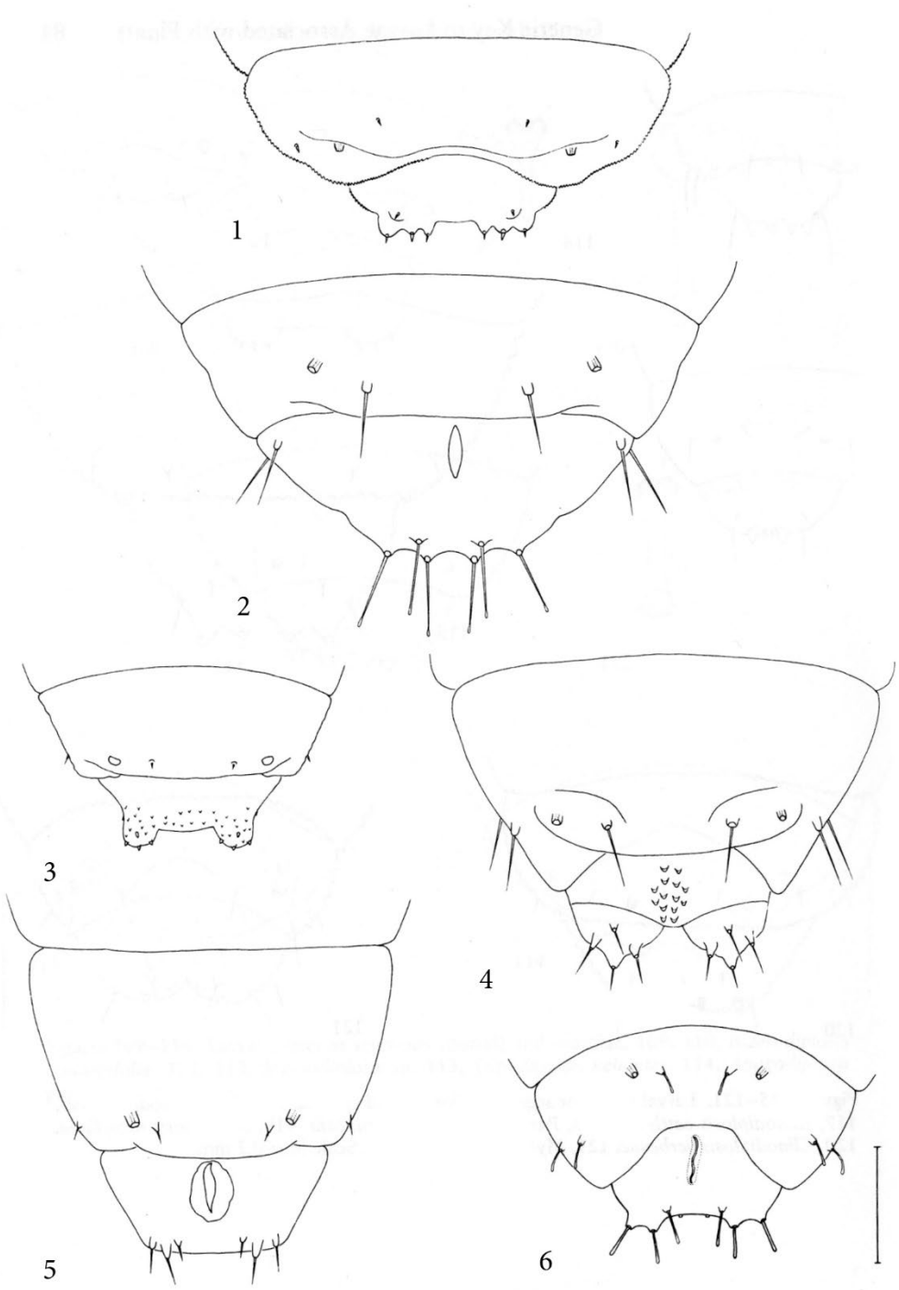


Plate 16. Larval posterior segments (dorsal). **1,** *Youngomyia podophyllae.* **2,** *Lestodiplosis sp.* **3,** *Karshomyia caulicola*. **4,** *Aphidoletes urticariae*. **5,** *Feltiella macgregori*. **6,** *Cartodiplosis nyssaecola*. Scale line: 1, 3, 4 = 0.2 mm; 2, 5, 6 = 0.1 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

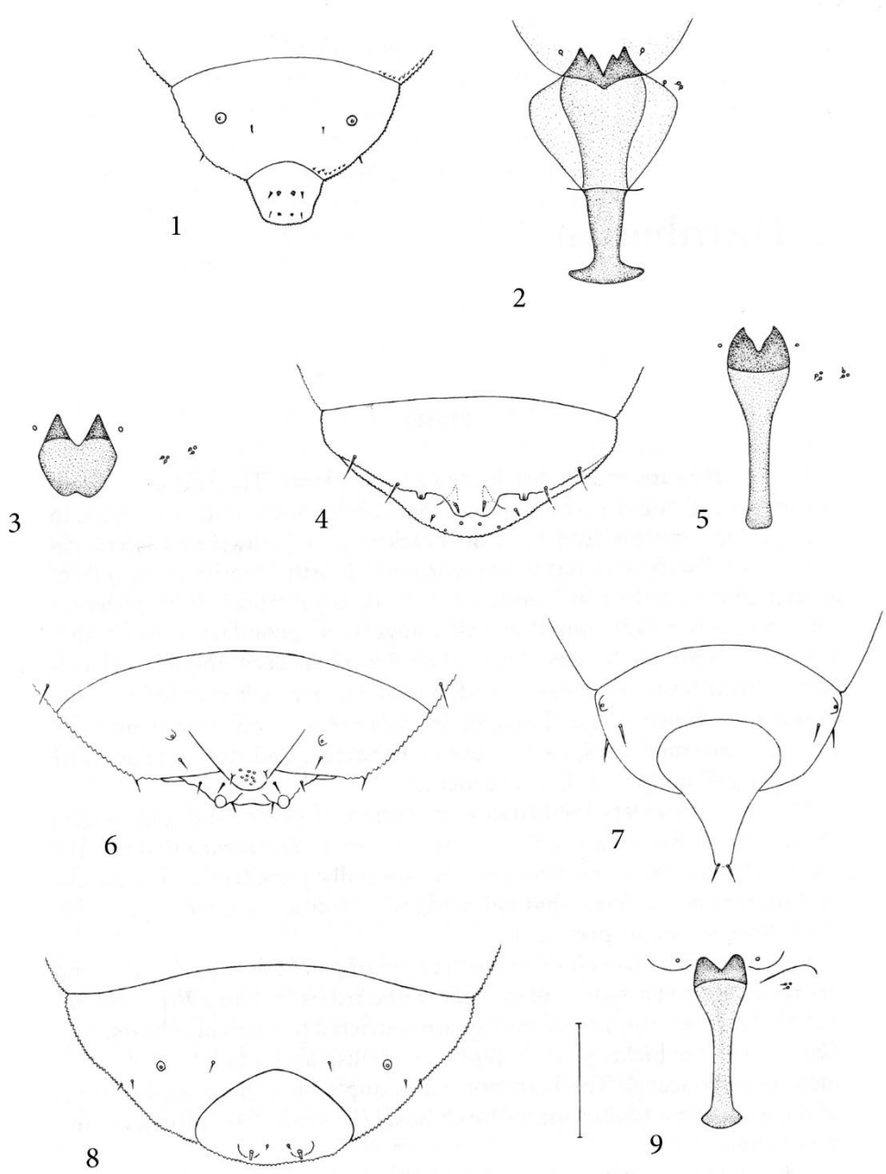


Plate 17. Larval posterior segments (dorsal) and spatulae with associated papillae. **1-2,** *Asphondylia websteri*. **3, 6,** *Ampelomyia vitispomum*. **4-5,** *Schizomyia impatientis*. **7,** *Bruggmannia* sp. **8-9,** *Polystepha pilulae*. Scale line = 0.2 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

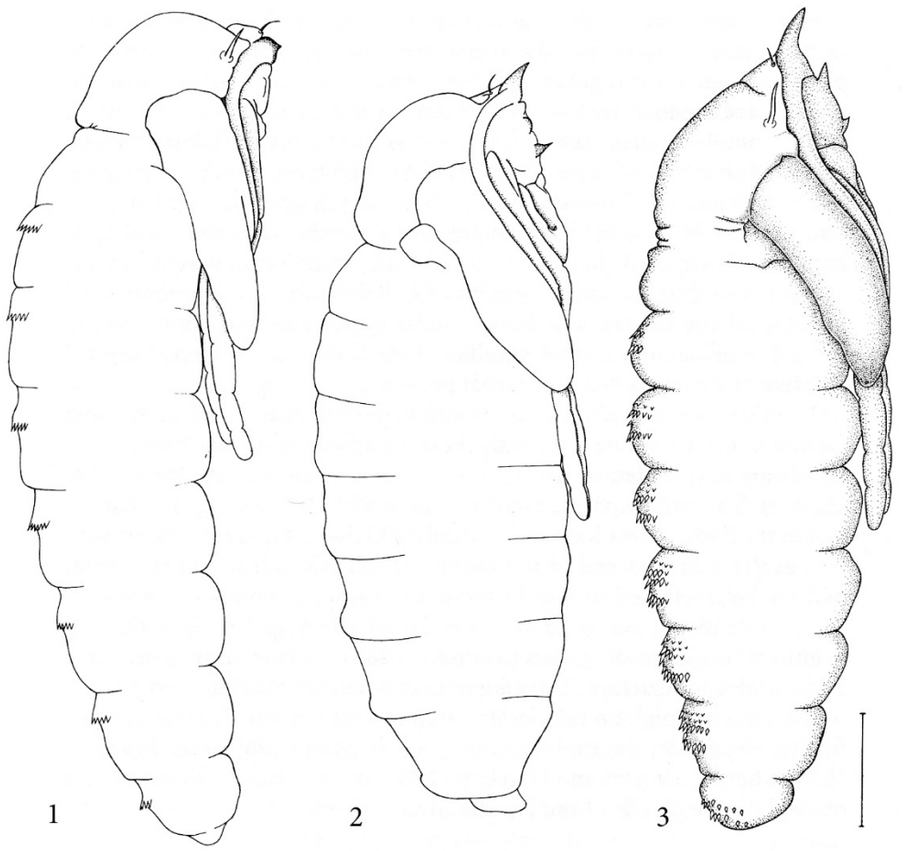


Plate 18. Pupae (lateral). **1,** *Contarinia sp.* **2,** *Rhopalomyia pomum.* **3,** *Asphondylia atriplicis*. Scale line = 0.5 mm. Gagné 1989.

To 2 Anatomy.
To 3 Biology.
To 4 Synopsis.

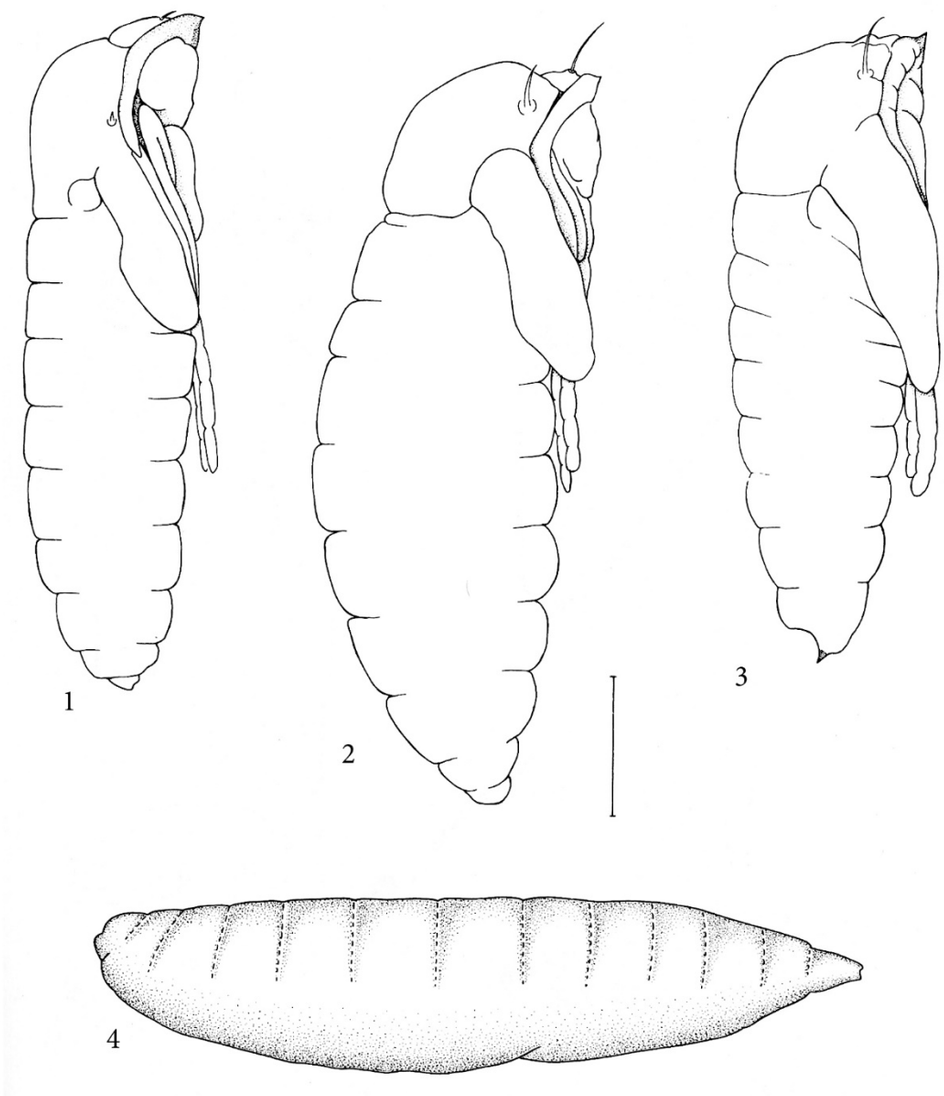


Plate 19. 1-3, Pupae; **4,** Puparium (lateral). **1,** *Neolasioptera sp.* **2,** *Dasineura gleditchiae.* **3,** *Monarthropalpus flavus*. **4,** *Mayetiola destructor*. Scale line = 0.5 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

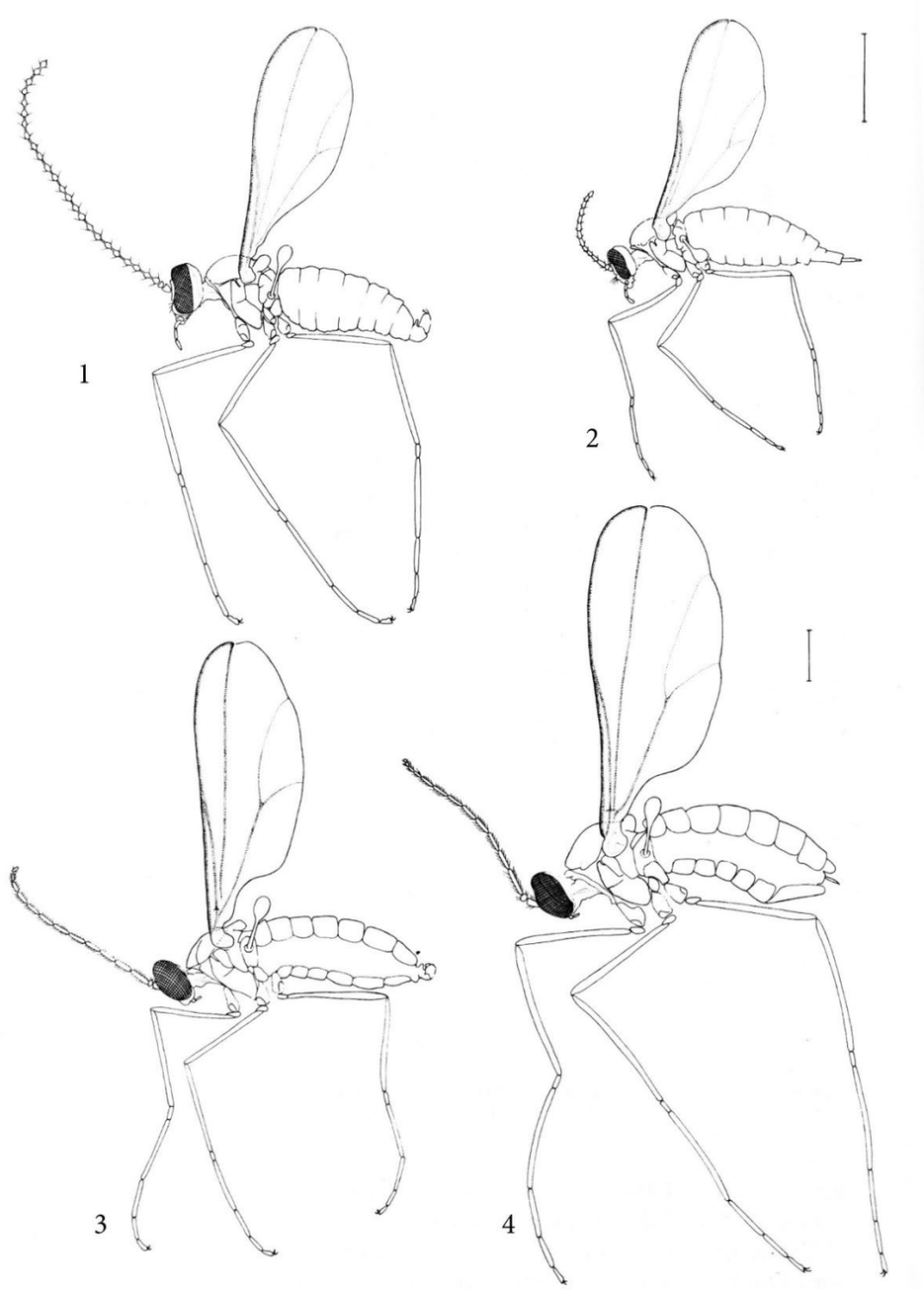


Plate 20. Adults; males on left, females on right. **1-2,** *Contarinia* sp. **3-4,** *Asphondylia atriplicis*. Scale line = 0.5 mm. Gagné 1989.

To 2 Anatomy.
To 3 Biology.
To 4 Synopsis.

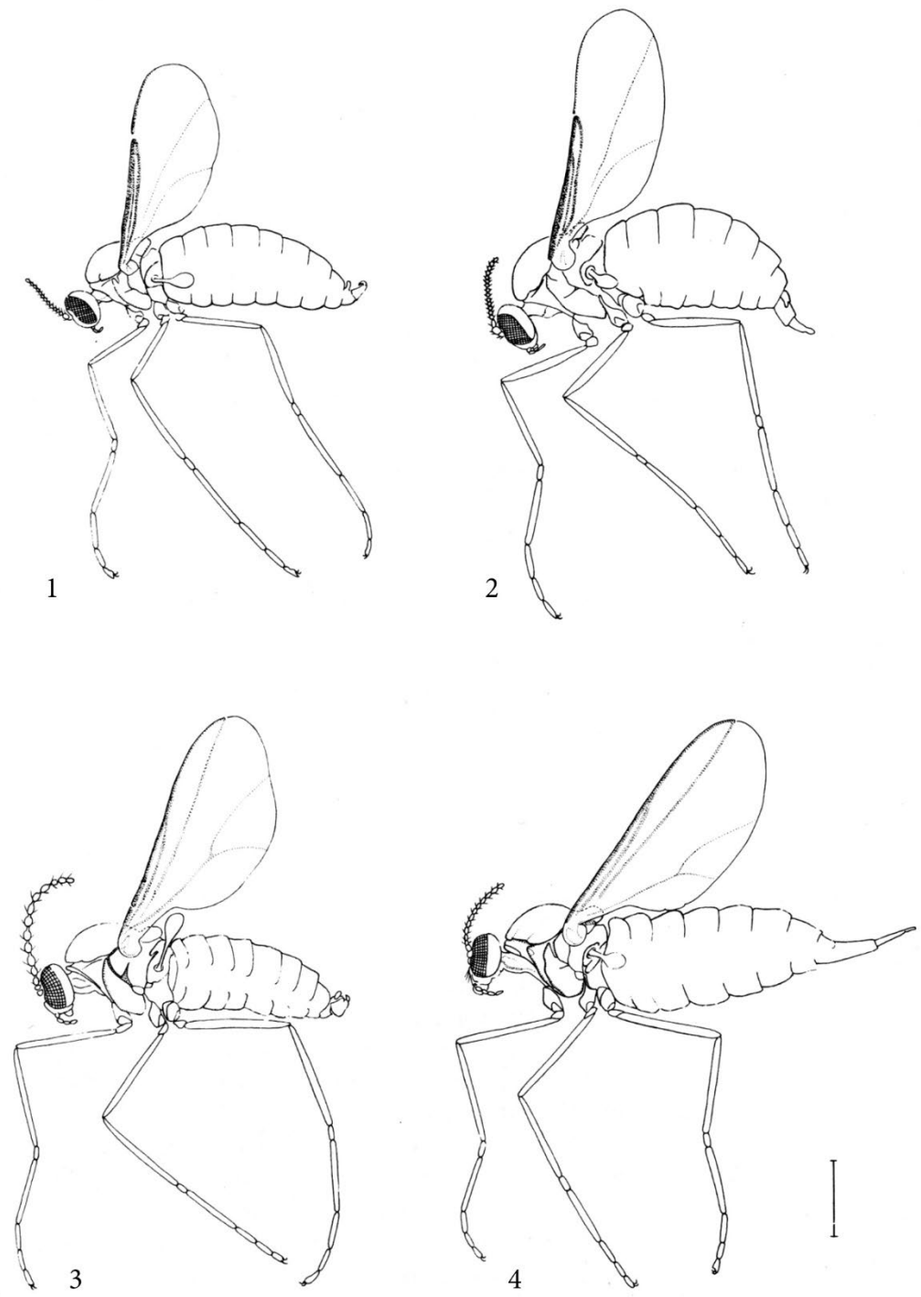


Plate 21. Adults; males on left, females on right. **1-2,** *Neolasioptera lathami.* **3-4,** *Dasineura gleditchiae*. Scale line = 0.5 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

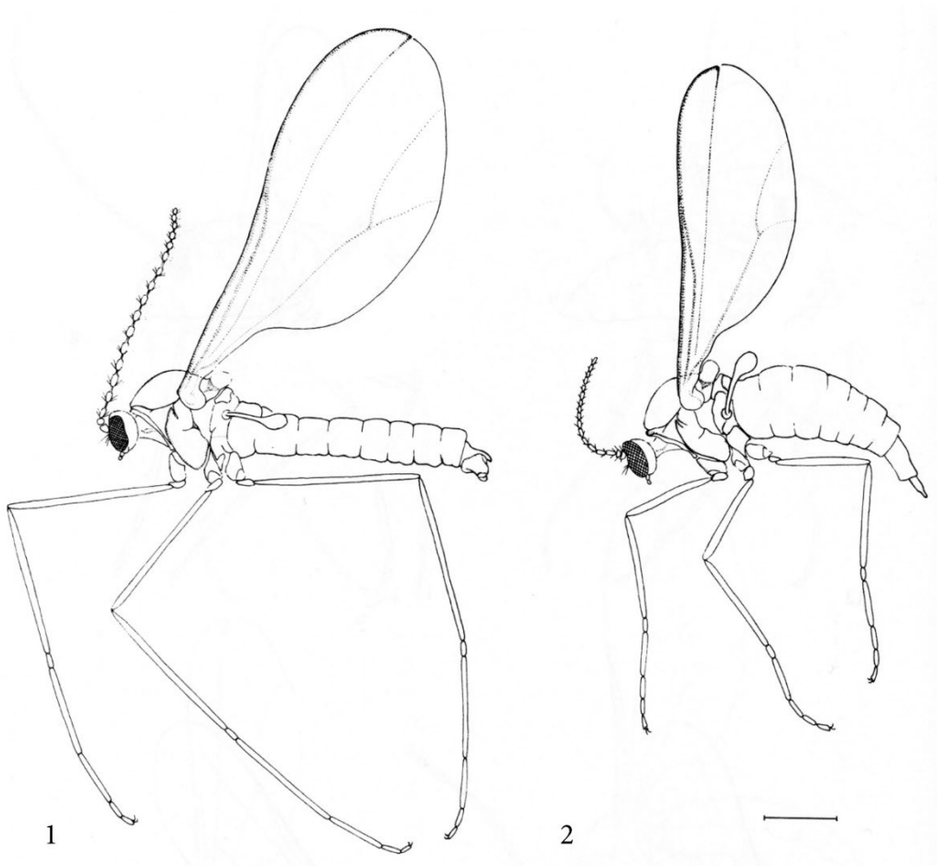


Plate 22. Adults, Rhopalomyia pomum (partially redrawn from Jones et al. 1983). **1,** male. **2,** female. Scale line = 0.5 mm. Gagné 1989.

To 2 Anatomy.
To 4 Synopsis.

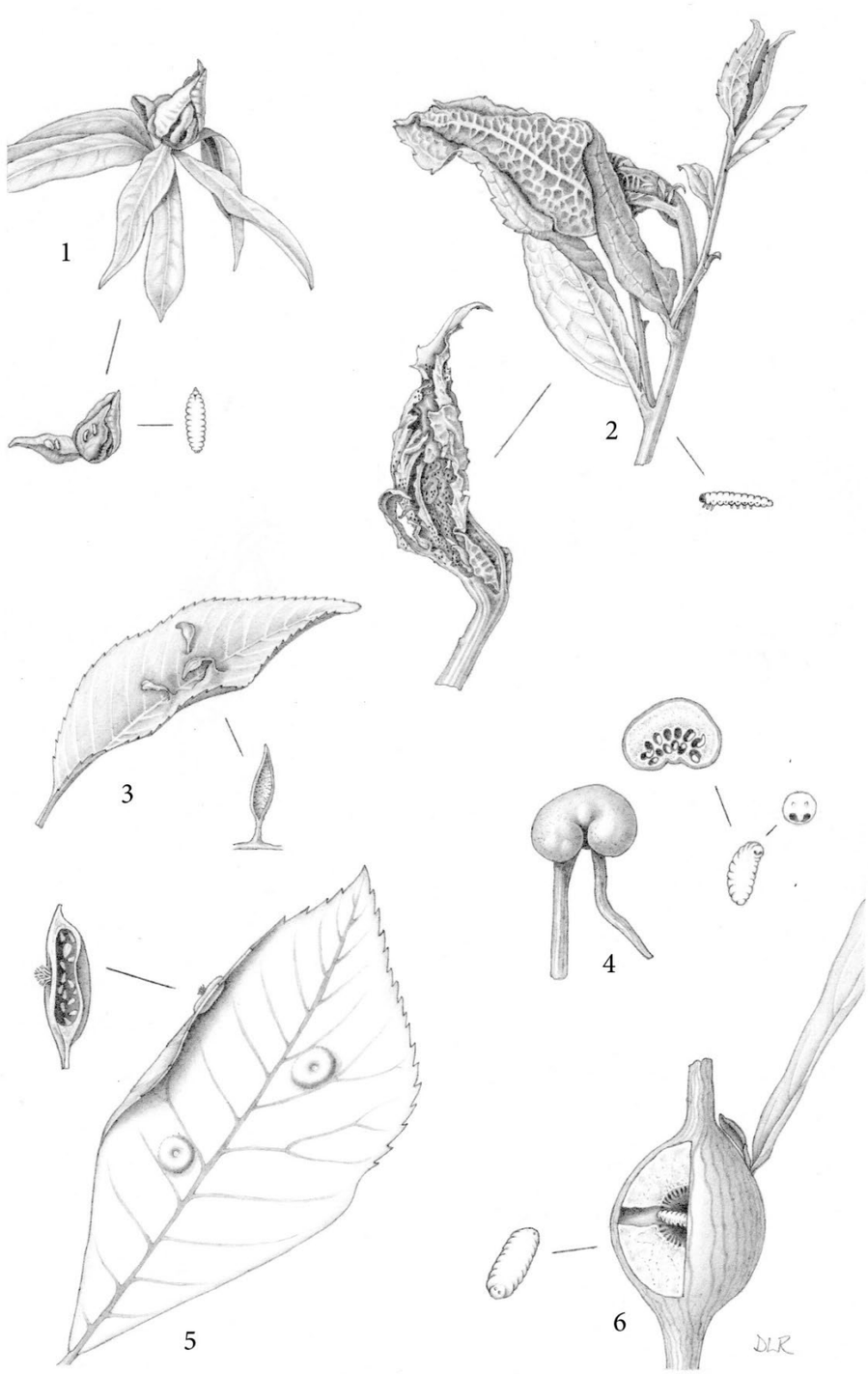


Plate 23. Galls made by various insect and mite gall makers. All are drawn to actual size unless otherwise noted. **1,** Enlarged buds, *Euphorbia esula*, one with outer buds removed to show larvae and cocoons; larva in 5x: *Dasineura* sp. near *capitigena* (Diptera: Cecidomyiidae). **2,** Composite leaf rolls, *Solidago rugosa*, one open to show chewed leaves and frass; caterpillar in 2x: *Gnorimoschema gallaesolidaginis* (Riley) **(**Lepidoptera: Gelechiidae). **3,** Leaf pouch galls, *Prunus serotina*, one in section, 2x: *Phytoptus cerasicrumena* Walsh (Acari: Eriophyidae). **4,** Kidney-shaped shoot galls, *Vaccinium angustifolium*, one in section; larva in 5x, head capsule in 10x: *Hemadas nubilipennis* (Ashmead) (Hymenoptera: Pteromalidae). **5,** Blister galls, *Carya ovalis*, one gall in cross section, 3x; female and nymphs: *Phylloxera* sp. (Hymenoptera: Phylloxeridae). **6,** Globular stem swelling, partly sectioned, *Solidago canadensis*; larva in 2x: *Eurosta solidaginis* (Fitch) (Diptera: Tephritidae). Gagné 1989.

To 6 Plant Galls.
To 8 Gall Keys (Ericaceae).
To 8 Gall Keys (Rosaceae).

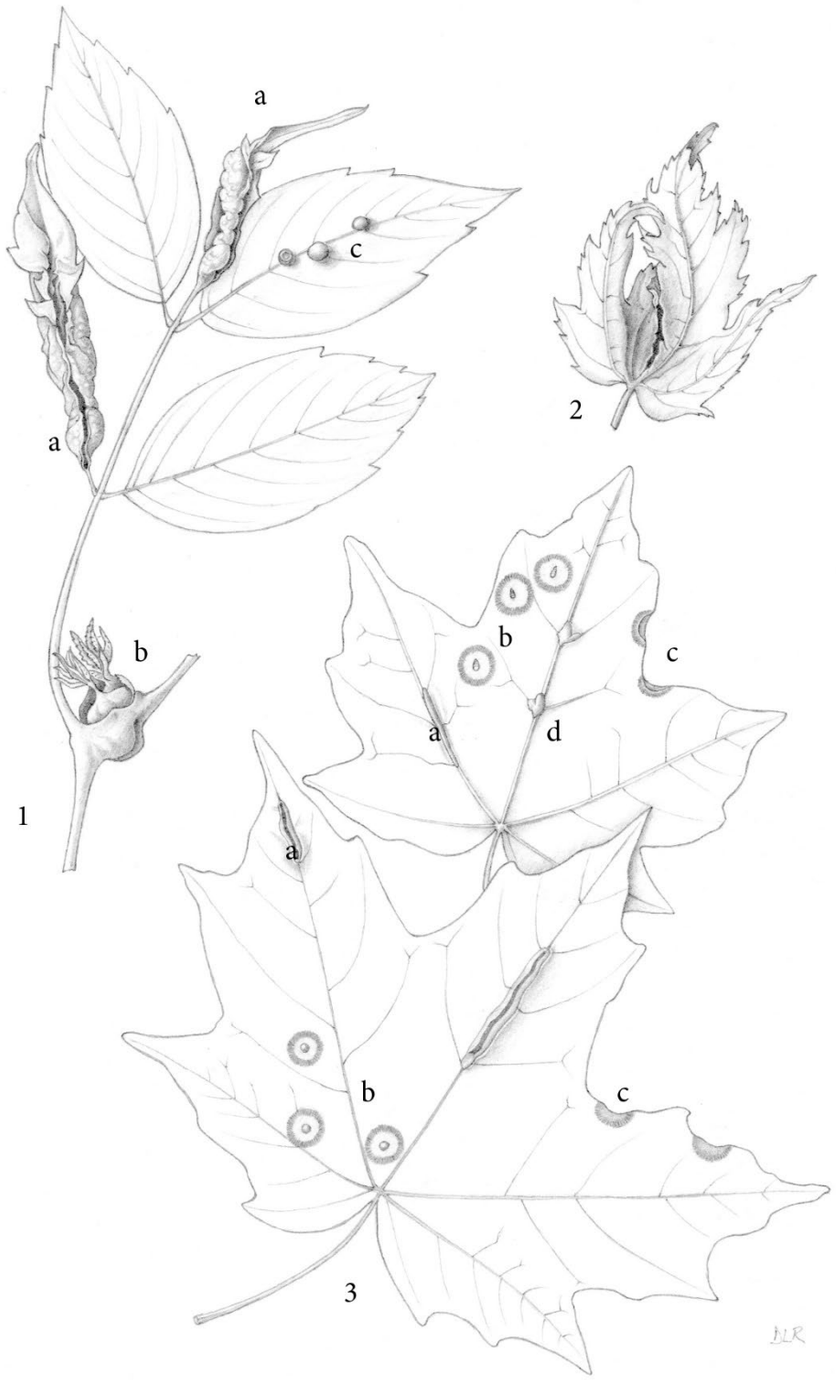


Plate 24. Sapindaceae. **1,** *Acer negundo*: **a,** swollen, folded lealets and **b,** swollen bud: *Contarinia negundinis*; **c,** globular pouch gall: *Contarinia* sp. **2,** Distorted leaf, *Acer saccharinum*: *Dasineura aceris*. **3,** Lower leaf surface (at top) and upper surface (at bottom), *Acer rubrum*: a, pouch galls: *Dasineura communis*; **b,** leaf spots: *Acericecis ocellaris*; **c,** rolled leaf margin: *Contarinia* sp. and *Dasineura* sp.; **d,** swollen vein gall: *Dasineura* sp. Gagné 1989.

To 6 Plant Galls.
To 8 Gall Keys (Sapindaceae).

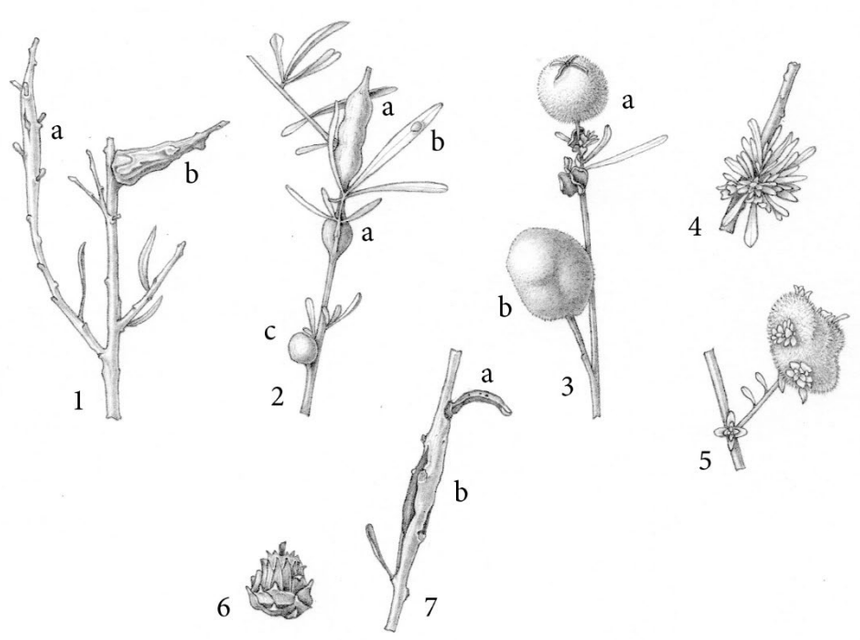


Plate 25. Amaranthaceae and Sarcobataceae. **1-3,** Galls of *Atriplex canescens*. **1,** Stem swellings, **a,** smooth: **b,** rough: *Neolasioptera willistoni*. **2, a,** tumor stem galls: *Asphondylia atriplicis*; **b,** blister leaf gall: *Asphondylia atriplicicola*; **c,** oval twig gall: *Asphondylia caudicis*. **3, a,** woolly bud gall: *Asphondylia neomexicana*; **b,** oval bud gall: *Asphondylia gemmae*. **4-5,** Galls of *Atriplex polycarpa*. **4,** Bud gall: *Ophiomyia atriplici*s (Diptera: Agromyzidae. **5,** Woolly stem gall: *Asphondylia floccosa*. **6-7,** Galls of *Sarcobatus vermiculatus*, **6,** Swollen bud, *Onodiplosis sarcobati*. **7a,** Swollen leaf, *Protaplonyx sacobati*, **7b,** Swollen stem, *Neolasioptera* sp. Gagné 1989.

To 6 Plant Galls.
To 8 Gall Keys (Amaranthaceae).
To 8 Gall Keys (Sarcobataceae).

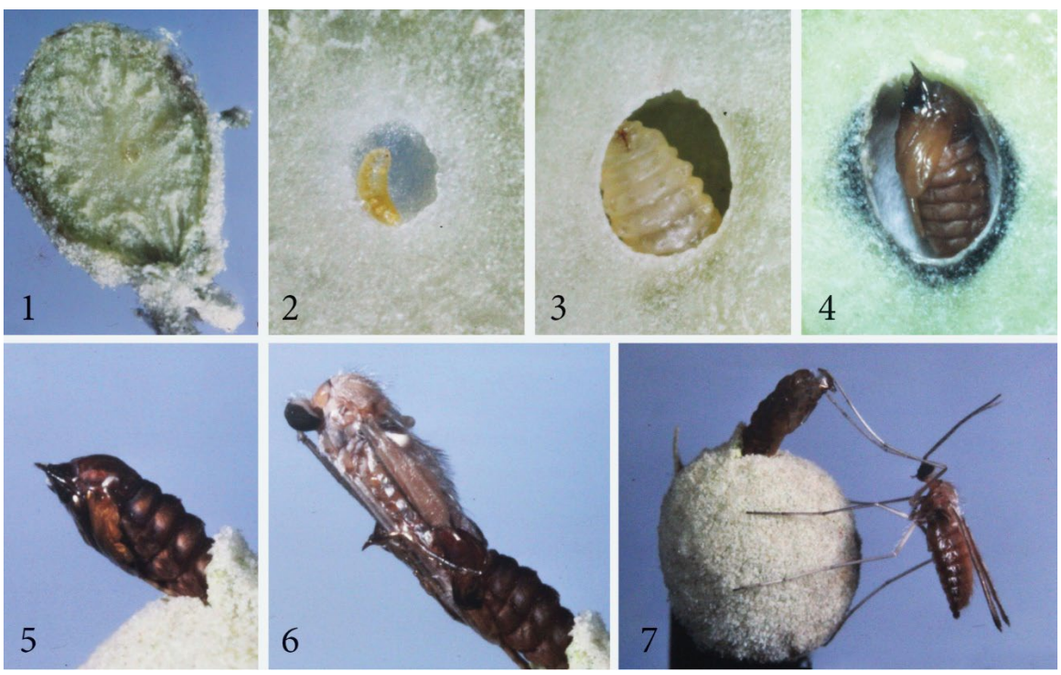


Plate 26. Amaranthaceae. Life cycle of the tumor stem gall midge *Asphondylia atriplicis* (Townsend) on *Atriplex canescens* (Amaranthaceae). **1-7. 1,** Cross-section of young gall. **2,** First instar. **3,** Third instar. **4,** Pupa. **5,** Emergent pupa. **6,** Emergent adult. **7,** Gall, pupal exuviae and adult male. Photos by Bradford A. Hawkins; some previously published in Gagné 1989.

To 3 Biology.
To 8 Gall Keys (Amaranthaceae).

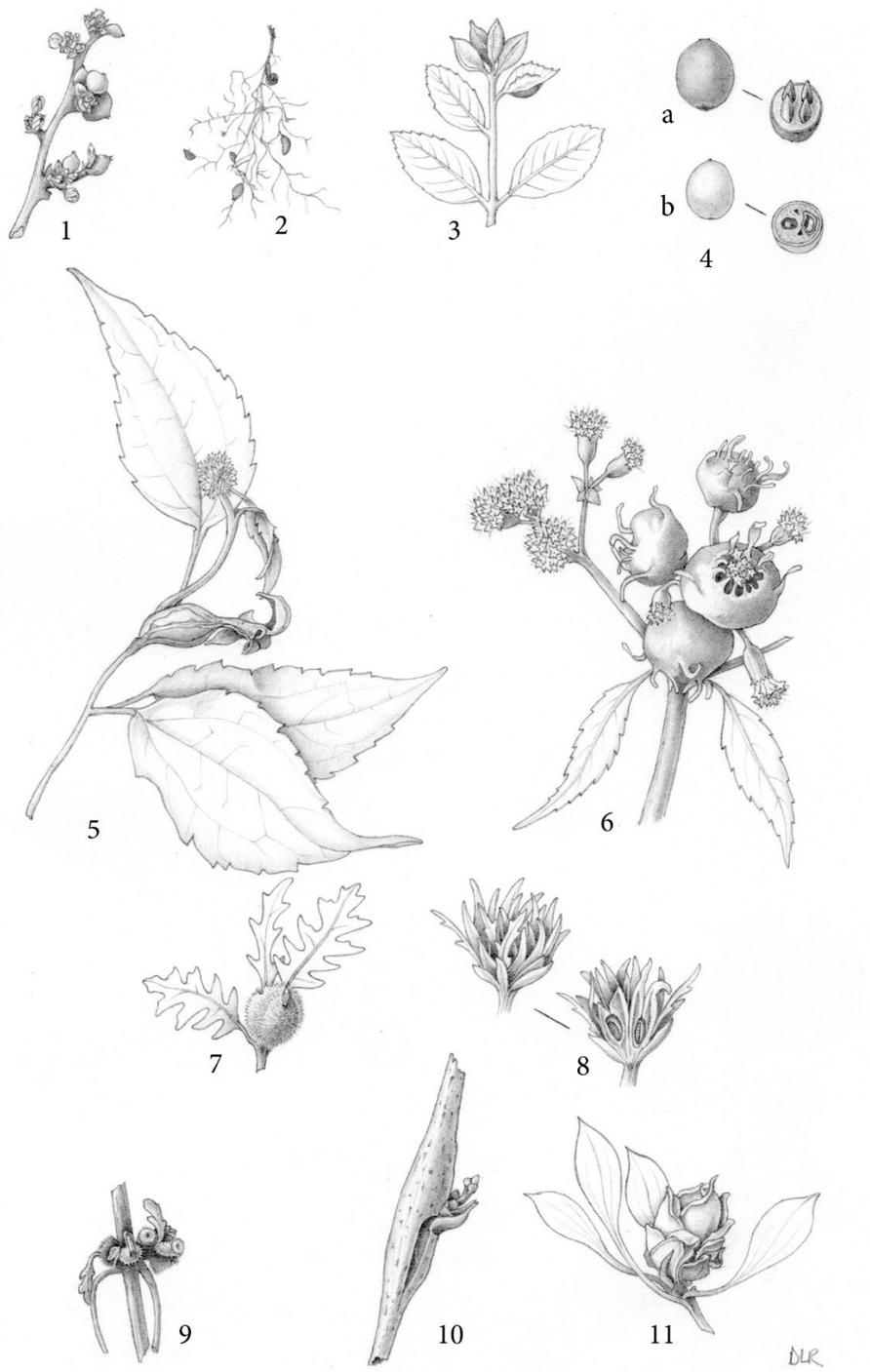


Plate 27. Anacardiaceae, Aquifoliaceae and Asteraceae. **1,** Bud galls of *Rhus integrifolia*: *Asphondylia integrifoliae*. **2,** Aerial rootlet swellings, *Toxicodendron radicans*: *Rhizococcis rhois*. **3,** Swollen, folded leaves, *Ilex vomitoria*: cecidomyiid (redrawn from Wells 1921b). **4,** Berries, *Ilex glabra*: **a,** normal berries (red), one in cross section to show normally developed seeds; **b,** berries (evergreen) infested by *Asphondylia illicicola*, one in cross section to show larval chamber and aborted or poorly developed seed. **5,** Stem swelling of *Ageratina altissima*, *Asphondylia eupatorii*. **6,** Flower gall of *Ageratina altissima*, *Schizomyia eupatoriflorae* (redrawn from Beutenmüller 1907). **7,** Bud galls, *Ambrosia artemisiifolia*: *Asphondylia ambrosiae*. **8,** Leafy bud galls, whole and in cross section, *Ambrosia psilostachya*: *Rhopalomyia ambrosiae*. **9,** Bud galls, *Ambrosia psilostachya*: *Contarinia partheniicola*. **10,** Swollen stem, *Ambrosia trifida*: *Neolasioptera ambrosiae*. **11,** Bud gall, *Antennaria plantaginifolia*: *Asphondylia antennariae*. Gagné 1989.

To 8 Gall Keys (Anacardiaceae).
To 8 Gall Keys (Aquifoliaceae).
To 8 Gall Keys (Asteraceae).

Plate 28. Asteraceae. Galls of *Artemisia tridentata*, all formed by *Rhopalomyia* spp. **1a,** Bud gall with cross section in 2x: *R. anthoides*; **b,** node gall: *R. nucula*; **c,** bud galls, *R. obovata*; **d,** bud gall: *R. lignitubus*; **e,** bud gall: *R. cranboides*; **f,** ephemeral leaf galls: *R. ampullaria*; **g,** ephemeral leaf gall: *R. culmata*; **h,** bud gall: *R. lignea*; **i,** leaf galls: *R. tubulus*; **j,** leaf galls, one in 2x: *R. hirtibulla*; **k,** bud gall, one in section: *R. conica*; **l,** leaf galls: *R. hirtipomum*; **m,** leaf gall: *R. pomum* (in section); **n,** leaf galls: *R. pomum*; **o,** leaf gall: *R. calvipomum*. **2,** Bud gall: *R. gossypina*. **3,** Node gall: *R. medusirrasa*. **4,** Node gall: *R. medusa*. Gagné 1989.

To 6 Plant Galls.
To 8 Gall Keys (Asteraceae).

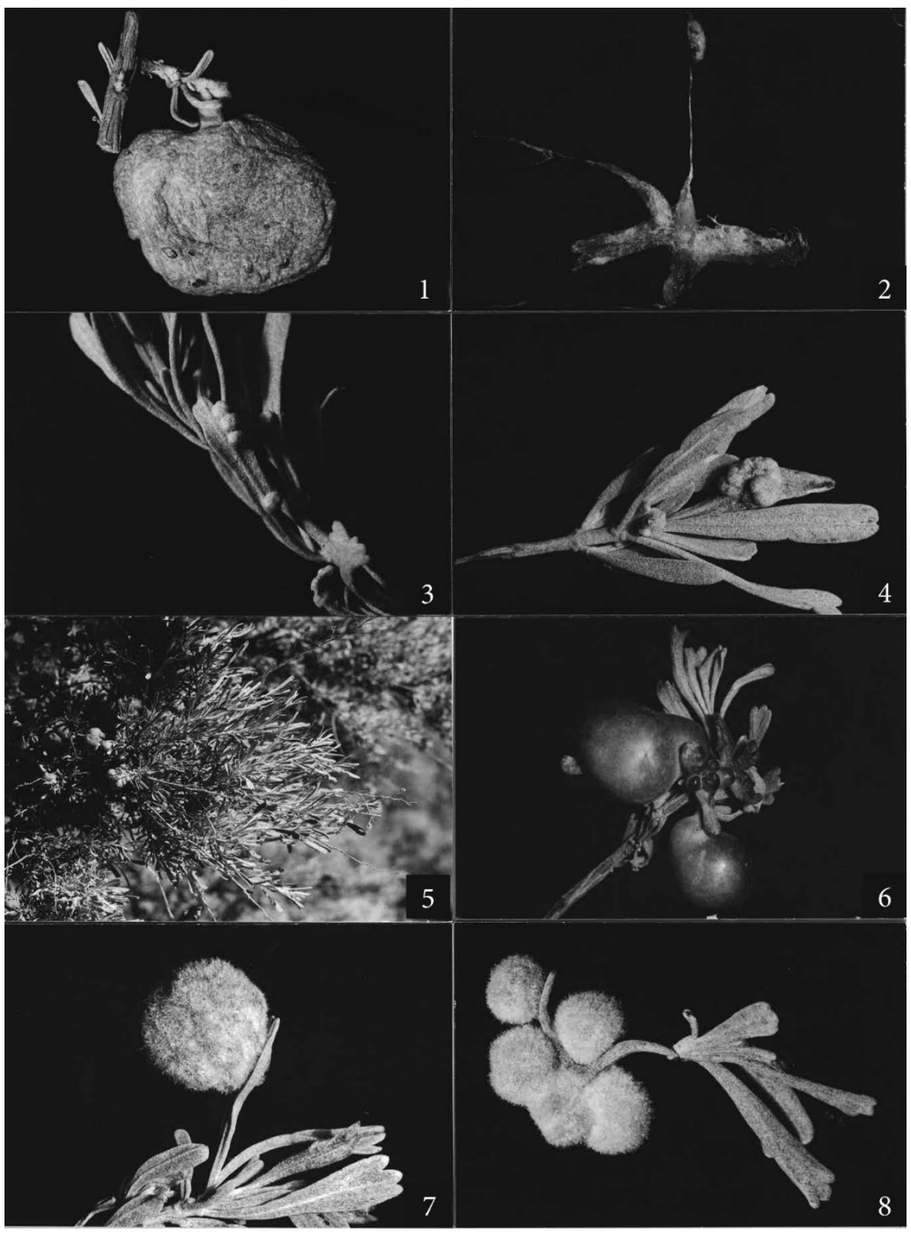


Plate 29. Asteraceae. Galls of *Artemisia tridentata*, all formed by *Rhopalomyia* spp. **1,** Polythalamous leaf gall with pupal exuviae and damaged bud, *R. pomum*. **2,** Larval capsule with fiber connection to surface, *R. pomum*. **3,** Immature galls, October, *R. pomum*. **4,** Immature galls, March, *R. pomum*. **5,** Mature galls, *R. pomum*. **6,** Mature, persistent leaf galls, *R. calvipomum*. **7,** Mature, persistent leaf gall, *R. hirtipomum*. **8,** Confluent, mature, persistent leaf galls, *R. hirtipomum*. Jones et al. 1983.

To 8 Gall Keys (Asteraceae).

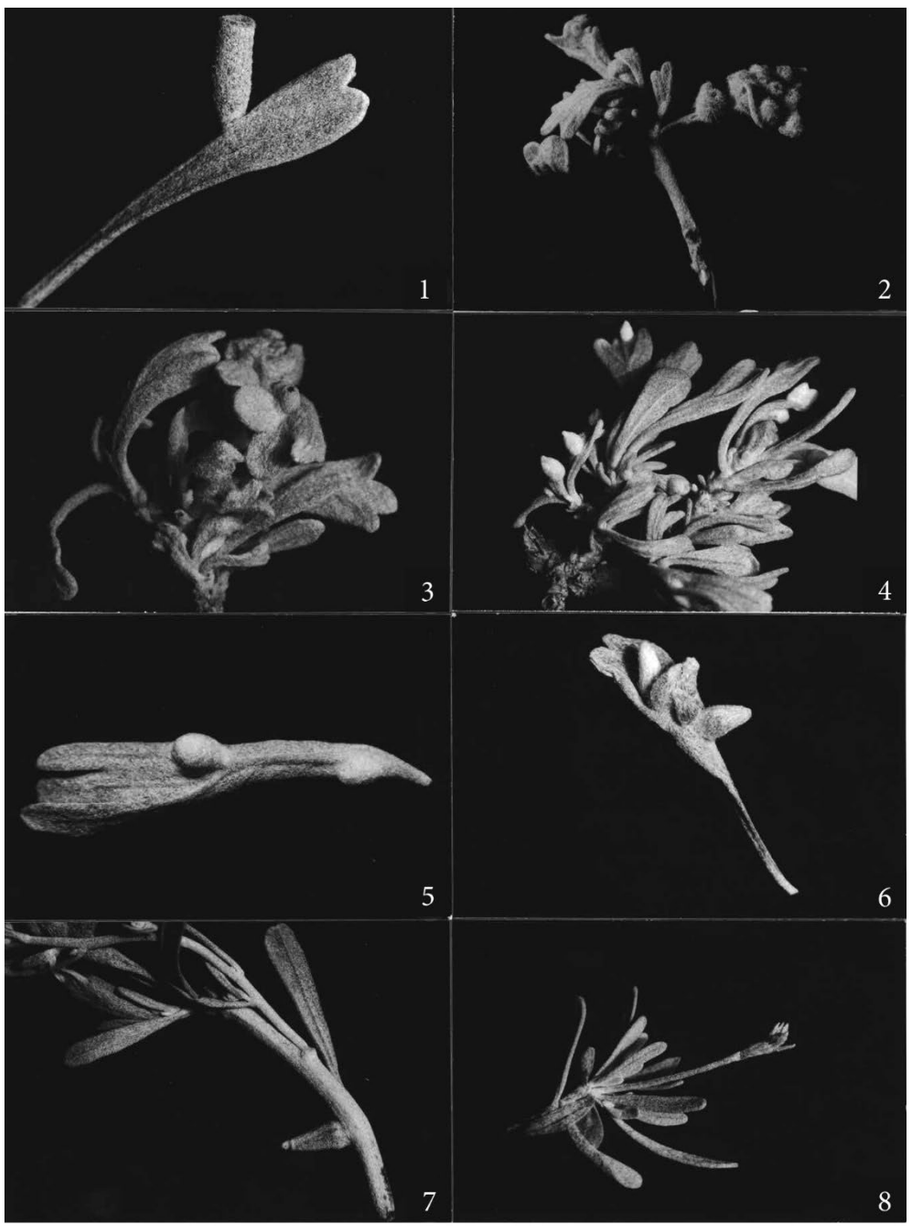


Plate 30. Asteraceae. Galls of *Artemisia tridentata*, all formed by *Rhopalomyia* spp. **1,** Mature, persistent leaf gall, *R. tubulus*. **2,** Mature, persistent leaf galls, *R. hirtibulla*. **3,** Mature, persistent leaf galls, *R. brevibulla*. **4,** Mature, persistent leaf galls, *Rhopalomyia* sp. 1. **5,** Mature, persistent leaf galls, *R. tumidibulla*. **6,** Mature ephemeral leaf galls, *R. ampullaria*. **7,** Mature stem gall, *R. ampullaria*. **8,** Mature ephemeral leaf gall, *R. culmata*. Jones et al. 1983.

To 8 Gall Keys (Asteraceae).

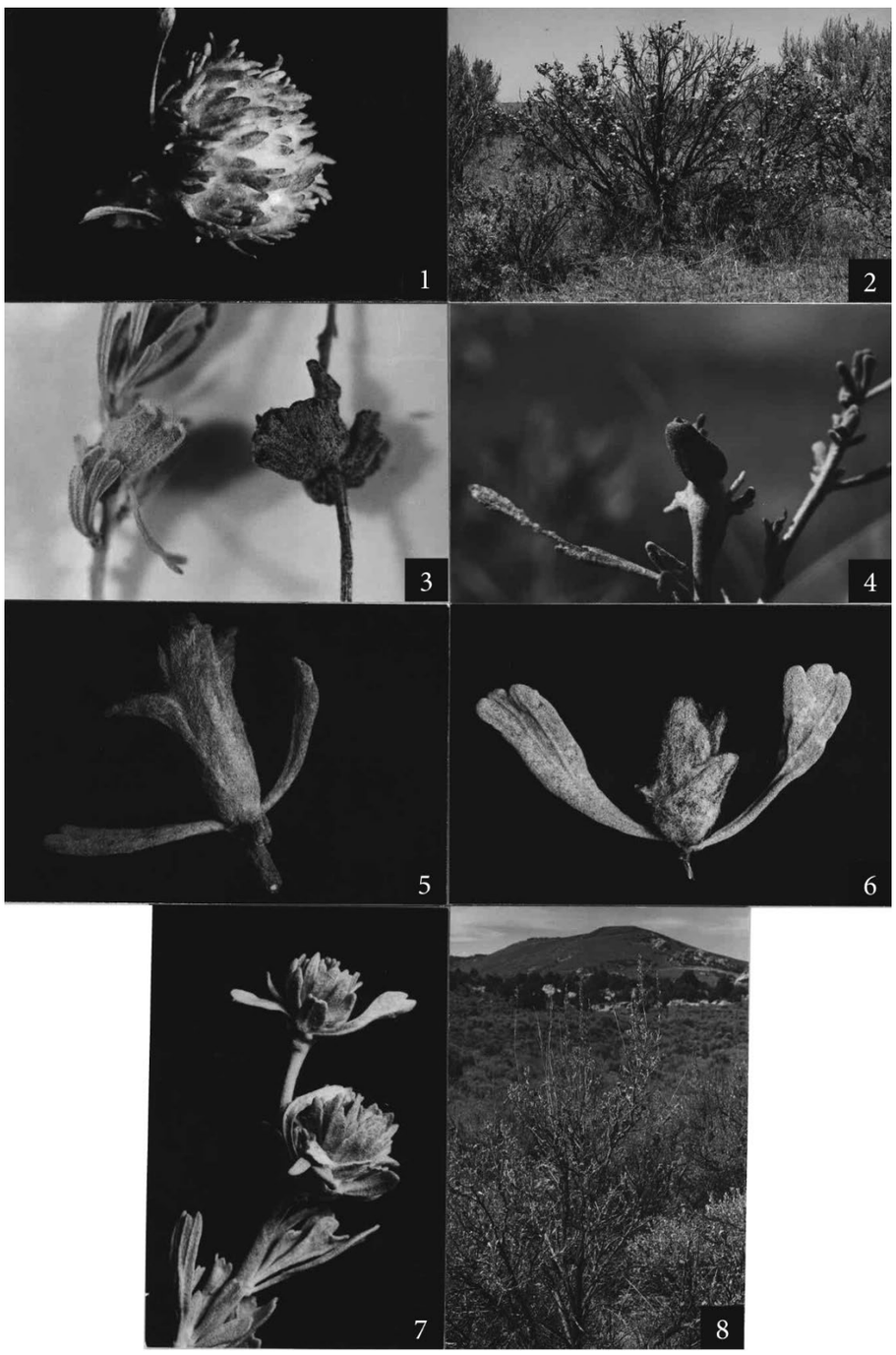


Plate 31. Asteraceae. Galls of *Artemisia tridentata*, all formed by *Rhopalomyia* spp. **1,** Mature, branch tip gall with pupal exuviae, *R. gossypina*. **2,** Plant mortality caused by *R. gossypina*. **3,** Mature and old bud galls, *R. lignea*. **4,** Mature bud gall, *Rhopalomyia* sp. near *R. lignea*. **5,** Mature bud gall, *R. lignitubus*. **6,** Immature bud gall, *R. lignitubus*. **7,** Mature bud galls, *R. cramboides*. **8,** Branch mortality caused by *R. cramboides*. Jones et al. 1983.

To 8 Gall Keys (Asteraceae).

Plate 32. Asteraceae. Galls of *Artemisia tridentata*, all formed by *Rhopalomyia* spp. **1,** Mature bud gall, *R. anthoides* on *A. t. wyomingensis*. **2,** Mature bud gall, *R. anthoides* on *A. t. vaseyana*. **3,** Mature bud gall, *R. florella*. **4,** Mature bud gall, *R. conica* on *A. t. tridentata*. **5,** Mature bud gall, *R. conica* on *A. t. wyomingensis*. **6,** Mature bud gall, *R. mamilla*. **7,** Mature bud gall, R. obovata. **8,** Mature, confluent node galls, *R. nucula*. Jones et al. 1983.

To 8 Gall Keys (Asteraceae).

Plate 33. Asteraceae. Galls of *Artemisia tridentata*, all formed by *Rhopalomyia* spp. **1,** Mature, solitary node galls, *R. nucula*. **2,** Mature node gall, *R. medusa* on *A. t. wyomingensis*. **3,** Mature node with fibrous mass removed and pupae exposed, *R. medusa*. **4,** Old node galls on *A. t. tridentata*, *R. medusa*. **5,** Immature node galls, *R. medusa*. **6,** Mature node gall, *R. medusirrassa*. **7,** Mature stem gall, *R. hirticaulis*. **8,** Mature, stem gall, *R. tumidicaulis*. Jones et al. 1983.

To 8 Gall Keys (Asteraceae).

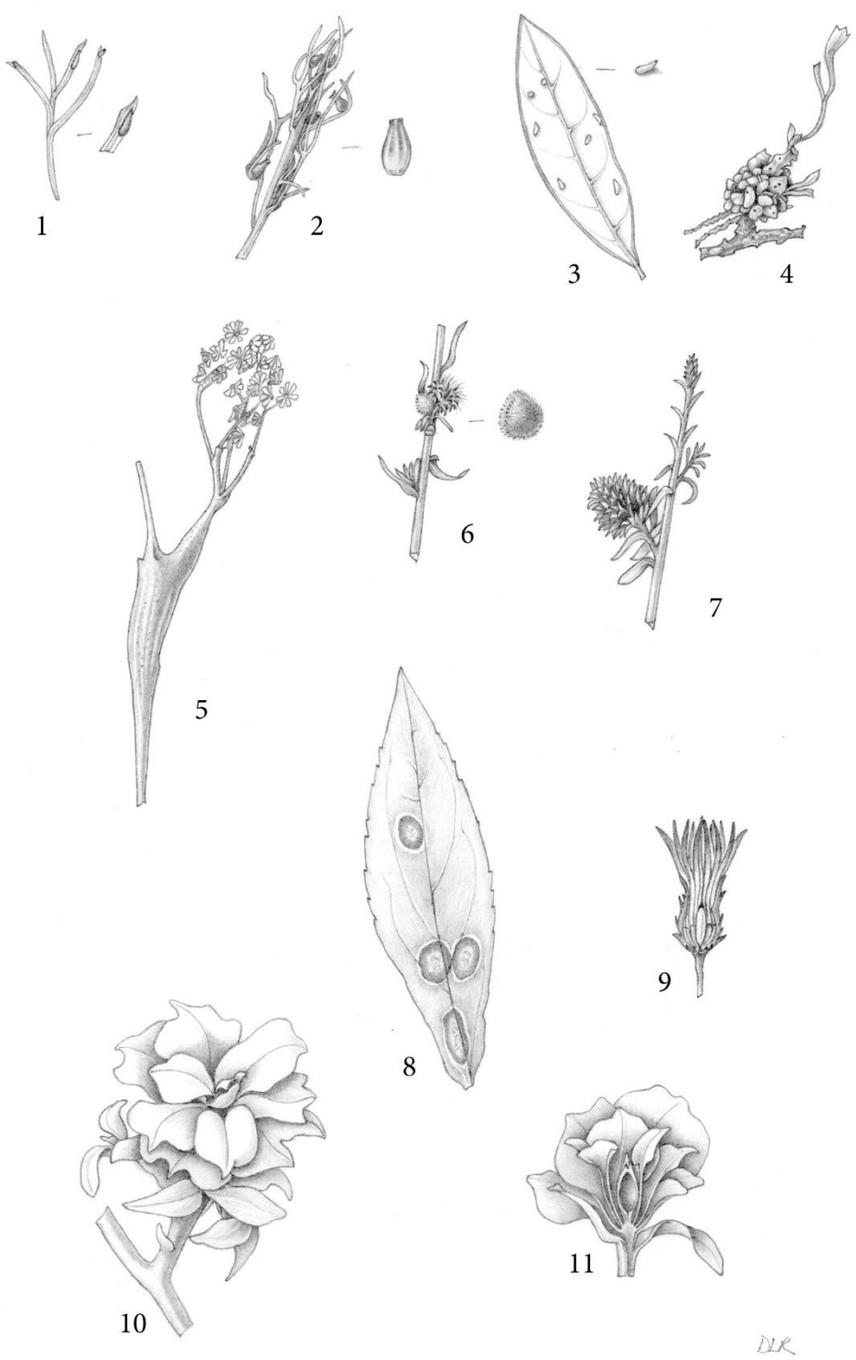


Plate 34. Asteraceae. **1,** Leaf galls, one in 2x, *Artemisia* "*californica*": *Rhopalomyia clinata*. **2,** Leaf galls, one in 2x, *Artemisia frigida*: *Rhopalomyia betheliana*. **3,** Leaf galls, one in 2x, *Artemisia furcata*: *Rhopalomyia occidentalis*. **4,** Subterranean node galls, *Artemisia ludoviciana*: *Rhopalomyia subhumilis*. **5,** Stem swelling, *Symphyotrichum patens*: *Neolasioptera ramuscula*. **6,** Ovoid bud gall, one in 2x, *Symphyotrichum lateriflorum*: *Rhopalomyia lateriflorae*. **7,** Foreshortened leafy stem, *Symphyotrichum ericoides*: *Rhopalomyia strobiligemma*. **8,** Leaf blisters, *Symphyotrichum* sp.: *Asteromyia laeviana*. **9,** Floret gall, section through flower head, *Symphyotrichum novae-angliae*: *Rhopalomyia* sp. **10,** Flower head gall, *Symphyotrichum patens*: *Asphondylia recondita* (redrawn from Beutenmüller 1907). **11,** Same, in cross section. Gagné 1989.

To 8 Gall Keys (Asteraceae).

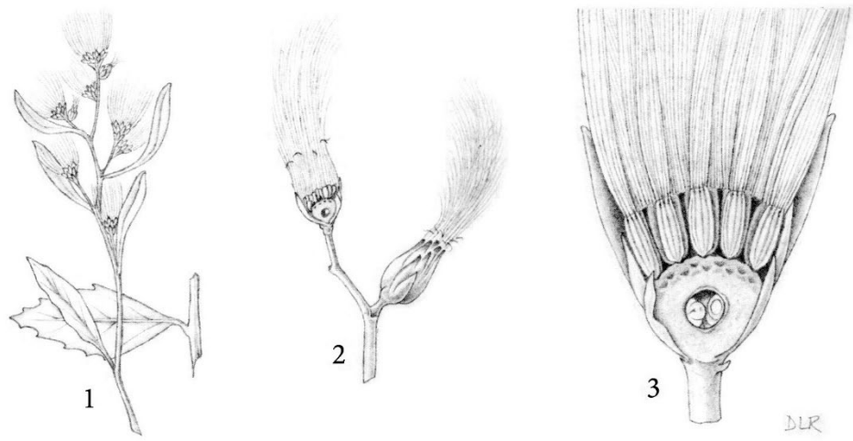


Plate 35. Asteraceae. *Baccharis halimifolia*: *Neolasioptera rostrata*. **1,** Flowering branchlet and leaf. **2,** Flower heads, one in sagittal section to show swollen receptacle, 2 x. **3,** Flower in sagittal section to show swollen receptacle and curled larva, 6 x. Gagné and Boldt 1989.

Plate 36. Asteraceae. *Baccharis* spp. **1,** Bud galls (1 and 2x), *B. pteronioides*: *Asphondylia baccharicola*. **2,** Stem gall (1x), *B. halimifolia*: *Neolasioptera lathami*. **3,** Bud galls (1 and 2x), *B. pilularis*: *Rhopalomyia californica*. **4,** Bud galls (1 and 2x), *B. salicifolia*: *Rhopalomyia sulcata*. **5,** Columnar galls, (1 and 2x) *B. neglecta*: *Rhopalomyia sulcata*. Gagné and Boldt 1995.

To 8 Gall Keys (Asteraceae).

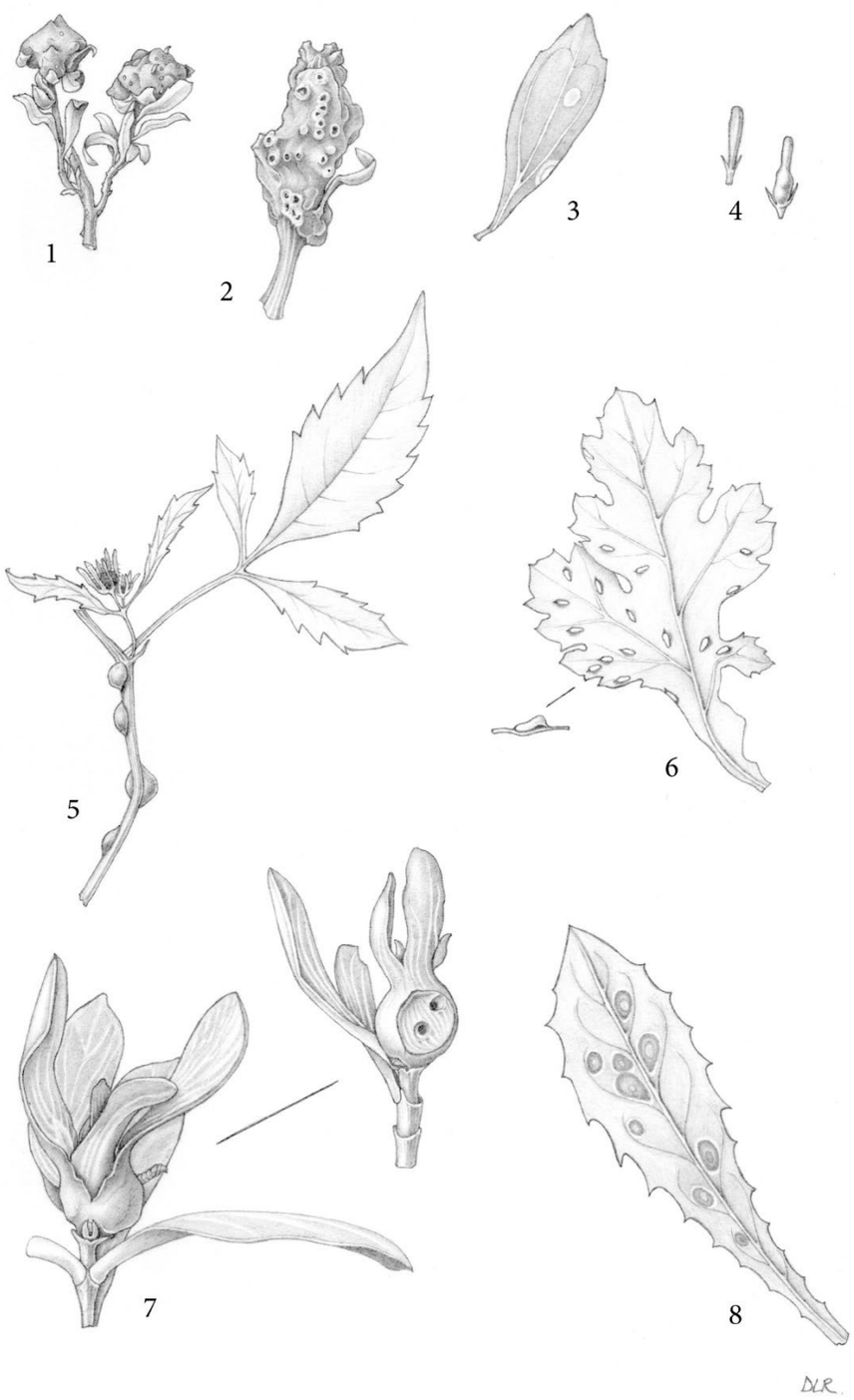


Plate 37. Asteraceae. **1,** Succulent bud galls showing exit holes and pupal exuviae, *Baccharis pilularis*: *Rhopalomyia californica*. **2,** Stem galls with exit holes, *Baccharis halimifolia*: *Neolasioptera lathami*. **3,** Blister leaf galls, *Baccharis angustifolia*: *Asteromyia* sp. **4,** Normal floret (left) and infested floret (right), *Bidens pilosa*: *Asphondylia bidens*. **5,** Globular stem swellings, *Bidens* sp.: *Asphondylia* sp. **6,** Leaf blisters, *Chrysanthemum* sp.: *Rhopalomyia chrysanthemi*. **7,** Succulent apical galls, one with pupa in exit hole, the other in section to show larval chambers, *Borrichia frutescens*: *Asphondylia borrichiae*. **8,** Leaf blisters, *Chondrilla juncea*: *Cystiphora schmidti*. Gagné 1989.

To 8 Gall Keys (Asteraceae).

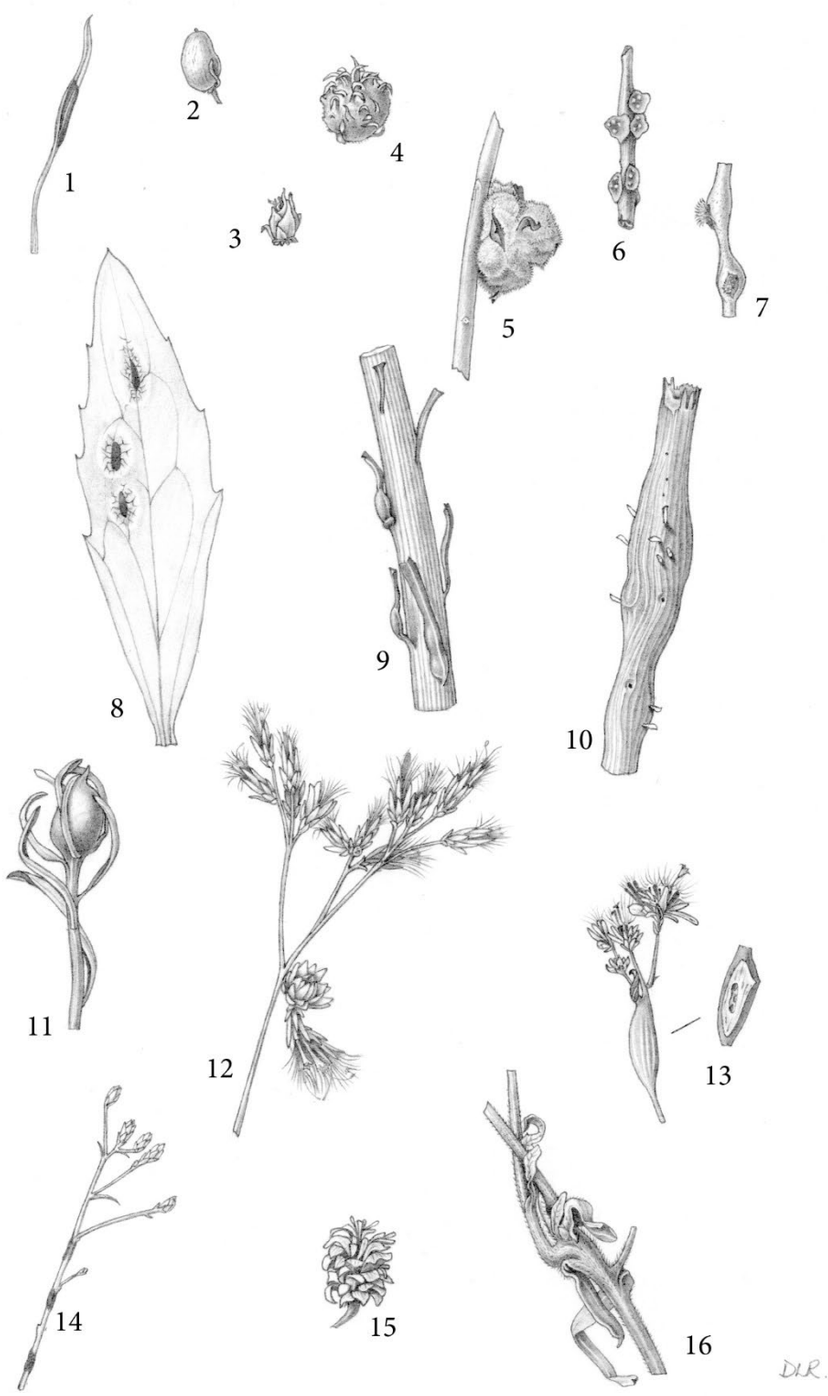


Plate 38. Asteraceae. **1,** Leaf blister, *Chrysothamnus* sp.: *Asteromyia chrysothamni*. **2,** Bud gall, *Chrysothamnus* sp.: *Rhopalomyia bigelovioides*. **3,** Bud gall, *Chrysothamnus* sp.: *Asphondylia bigeloviaebrassicoides*. **4,** Bud gall, *Chrysothamnus* sp.: *Rhopalomyia utahensis*. **5,** Node gall, *Chrysothanus* sp.: *Rhopalomyia* ?*utahensis*. **6,** Resinous stem galls, *Ericameria* sp.: *Rhopalomyia glutinosa*. **7,** Cottony stem galls, *Ericameria* sp.: *Rhopalomyia chrysothamni*. **8,** Leaf gall, *Conyza canadensis*: *Asteromyia modesta*. **9,** Petiole swellings, *Conyza canadensis*: *Asteromyia modesta*. **10,** Stem swelling with emergence holes and pupal exuviae, *Conyza canadensis*: *Neolasioptera erigerontis*. **11,** Bud gall, *Erigeron* "*fragilis*": *Rhopalomyia erigerontis*. **12,** Enlarged flower bud (at lowest fork), *Eutrochium purpureum*: *Dasineura purpurea*. **13,** Stem galls, one in section, *Eupatorium hyssopifolium*: *Neolasioptera perfoliata*. **14,** Stem blisters, *Gutierrezia sarothrae*: *Asteromyia gutierreziae*. **15,** Rosette bud gall, *Ericameria palmeri*: *Rhopalomyia ericameriae*. **16,** Fuzzy stem swellings, *Pseudognaphalium* sp.: *Asphondylia* sp. Gagné 1989.

To 8 Gall Keys (Asteraceae).

Plate 39. Asteraceae. *Euthamia graminifolia*. **1-8. 1,** aborted flower buds, one in 2 x: *Asphondylia pseudorosae*; **2,** swollen branch buds: *Asphondylia* sp.; **3,** pedicelled, ribbed galls on leaves, stems, and flowers: *Rhopalomyia pedicellata*; **4,** spongy flower head galls: *Rhopalomyia lobata*; **5,** stem blisters: *Asteromyia euthamiae*; **6,** sessile, ribbed galls on stems and leaves (one in 2 x with pupal exuviae in emergence hole): *Rhopalomyia fusiformae*; **7,** two-leaf gall: *Asphondylia pseudorosae*; **8,** leaf blister galls: *Asteromyia euthamiae*. Gagné 1989.

To 8 Gall Keys (Asteraceae).

Plate 40. Asteraceae. **1–4,** Inflorescence and galls of *Eutrochium purpurea*: *Anthodiplosis eutrochii*. **1,** Inflorescence with galls indicated by arrows (actual size). **2,** Gall, detail. **3,** Gall with bracts removed to reveal third instar in center. **4,** Same, third instar between outer bracts. Gagné 2016.

To 8 Gall Keys (Asteraceae).

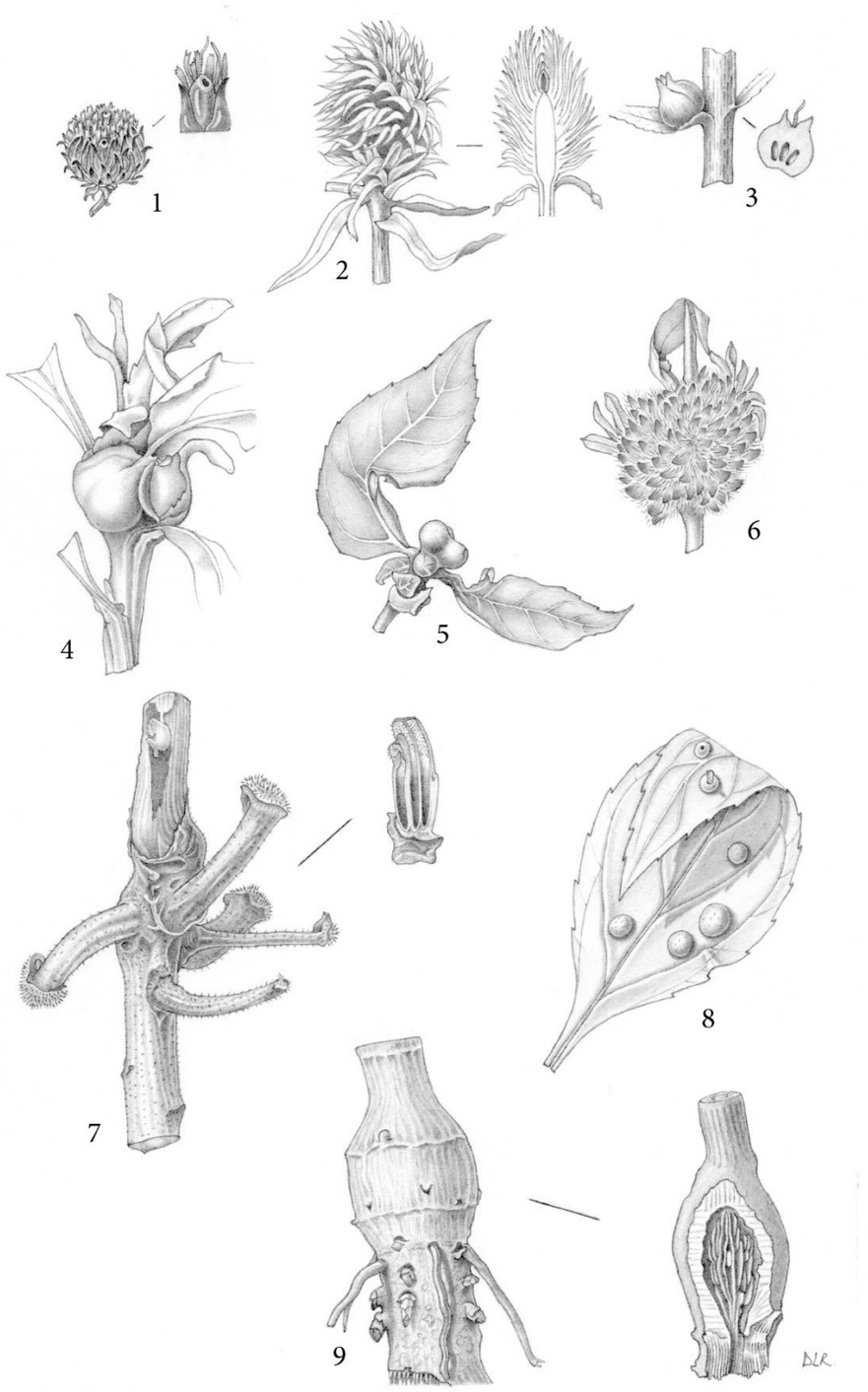


Plate 41. Asteraceae. **1,** Modified florets with enlargement of one gall in 2x, *Grindelia* "*cuneifolia*": *Rhopalomyia grindeliae*. **2,** Rosette gall, one sectioned to show single larval chamber at apex, *Grindelia lanceolata*: cecidomyiid (redrawn from Wells 1921b). **3,** Swollen lateral buds, one sectioned to show larval chambers, *Grindelia squarrosa*: cecidomyiid (redrawn from Wells 1921b). **4,** Apical bud gall, *Helenium autumnale*: *Asphondylia autumnalis* (redrawn from Beutenmüller 1907), **5,** Bud galls, *Helianthus grosseserratus*: *Asphondylia helianthiglobulus*. **6,** Leafy bud gall, *Chrysopsis mariana*: *Rhopalomyia chrysopsidis*. **7,** Tubular stem galls, one in section, *Helianthus tuberosus*: *Olpodiplosis helianthi*. **8,** Leaf blister galls, one with pupal exuviae attached to exit hole on underside of leaf, *Helianthus tuberosus*: *Pilodiplosis helianthibulla*. **9,** Swellings at base of stem, one sectioned to show larval tunnels in pith, *Helianthus divaricatus* *Neolasioptera* sp. Gagné 1989.

To 8 Gall Keys (Asteraceae).

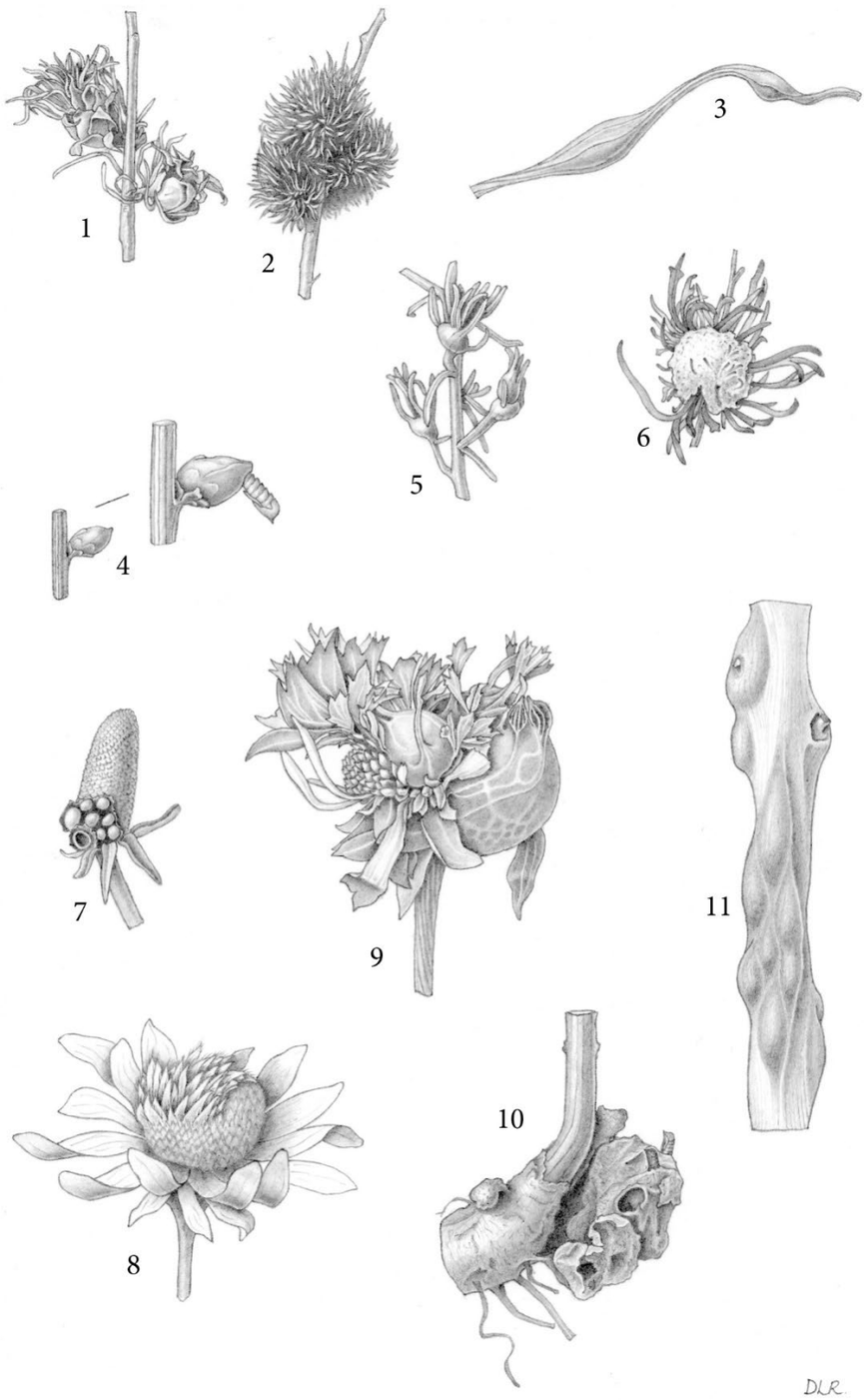


Plate 42. Asteraceae. **1-2,** Bud galls, *Gutierrezia* sp.: *Rhopalomyia* spp. **3,** Stem swellings, *Mikania scandens*: *Neolasioptera* sp. **4-6,** Bud galls, *Ambrosia salsola*: *Asphondylia* spp., **4** with specimen on right in 2x and with pupa protruding. **7,** Floret galls, *Ratibida columnifera*: *Asphondylia ratibidae* (after photograph in Felt 1940). **8,** Leafy flower gall, *Rudbeckia hirta*: cecidomyiid. **9-10**, Bud and root crown galls, respectively, *Rudbeckia laciniata*: *Asphondylia rudbeckiaeconspicua*. **11,** Stem swellings, *Lactuca canadensis*: *Lasioptera lactucae*. Gagné 1989.

To 8 Gall Keys (Asteraceae).

Plate 43. Asteraceae. *Solidago* spp. **1,** Clustered bud galls, *S. fistulosa*: *Rhopalomyia racemicola*. **2,** Galls on *S. altissima*: **a,** onion-shaped flower gall: *Schizomyia racemicola*; **b,** vase-shaped flower gall: *Rhopalomyia anthophila*; **c.** cylindrical flower gall: *Rhopalomyia* sp.; **d,** cabbagelike galls, one sectioned to show central larval chamber amid modified, linear leaves: *Rhopalomyia* solidaginis. **3,** Galls on *S. altissima*: **a,** blister galls: *Asteromyia carbonifera*; **b,** two-leaf blister galls with 2x enlargement of the two leaves pulled apart: *Asphondylia solidaginis*; **c,** conical leaf gall: *Rhopalomyia clarkei*. **4,** Spongy stem galls with exserted pupal exuviae, *S. altissima*: *Asteromyia tumifica*. Gagné 1989.

To 8 Gall Keys (Asteraceae).

Plate 44. Asteraceae. *Solidago* spp. **1-2,** Leaf cluster galls, *S. juncea*: *Asphondylia monacha*. **1,** Galls in aggregate. **2,** Two separated galls, one with some leaves removed to show central larval chamber. **3,** Galls on *S. juncea*: **a,** soft, apical stem gall, all but one of rosette of leaves removed: *Rhopalomyia hirtipes*; **b,** leaf blister galls: *Asteromyia carbonifera*. **4,** Bulblet galls near stem base, *S. juncea*: *Rhopalomyia bulbula* (after photograph in Felt 1940). **5,** Woody stem galls, one sectioned, *S. altissima*: *Lasioptera solidaginis*. **6,** Bulblet galls near stem base, *S. juncea*: *Rhopalomyia hirtipes* (after photograph in Felt 1940). Gagné 1989.

To 8 Gall Keys (Asteraceae).

Plate 45. Asteraceae, Fabaceae, Polemoniaceae, Rosaceae and Verbenaceae. **1,** Stem swellings, one sectioned to show larval tunnels, *Verbesina alternifolia*: *Neolasioptera verbesinae*. Fig. **2,** Rosette bud gall, *Desmodium canadense*: *Clinodiplosis meibomiifoliae*. **3,** Rolled leaves, *Verbena hastata*: *Clinodiplosis verbenae*. **4,** Flower bud galls, *Gutierrezia sarothrae*: *Rhopalomyia gutierreziae*. **5,** Spiny, spherical, leaf gall. *Rubus* sp.: "*Cecidomyia*" *muscosa*. **6,** Swollen, aborted buds, one sectioned, *Verbesina alternifolia*: *Schizomyia verbesinae* (redrawn from Beutenmüller 1907). **7**, Bud gall, *Aster subulatus*: *Asphondylia* sp. **8,** Healthy and injured buds, some leaves of one bud (enlarged to approximately 3x) removed to show larvae, *Phlox* sp.: *Clinodiplosis phlox* (redrawn from Neiswander 1962). Gagné 1989.

To 8 Gall Keys (Asteraceae).
To 8 Gall Keys (Fabaceae).
To 8 Gall Keys (Polemoniaceae).
To 8 Gall Keys (Rosaceae).
To 8 Gall Keys (Verbenaceae).

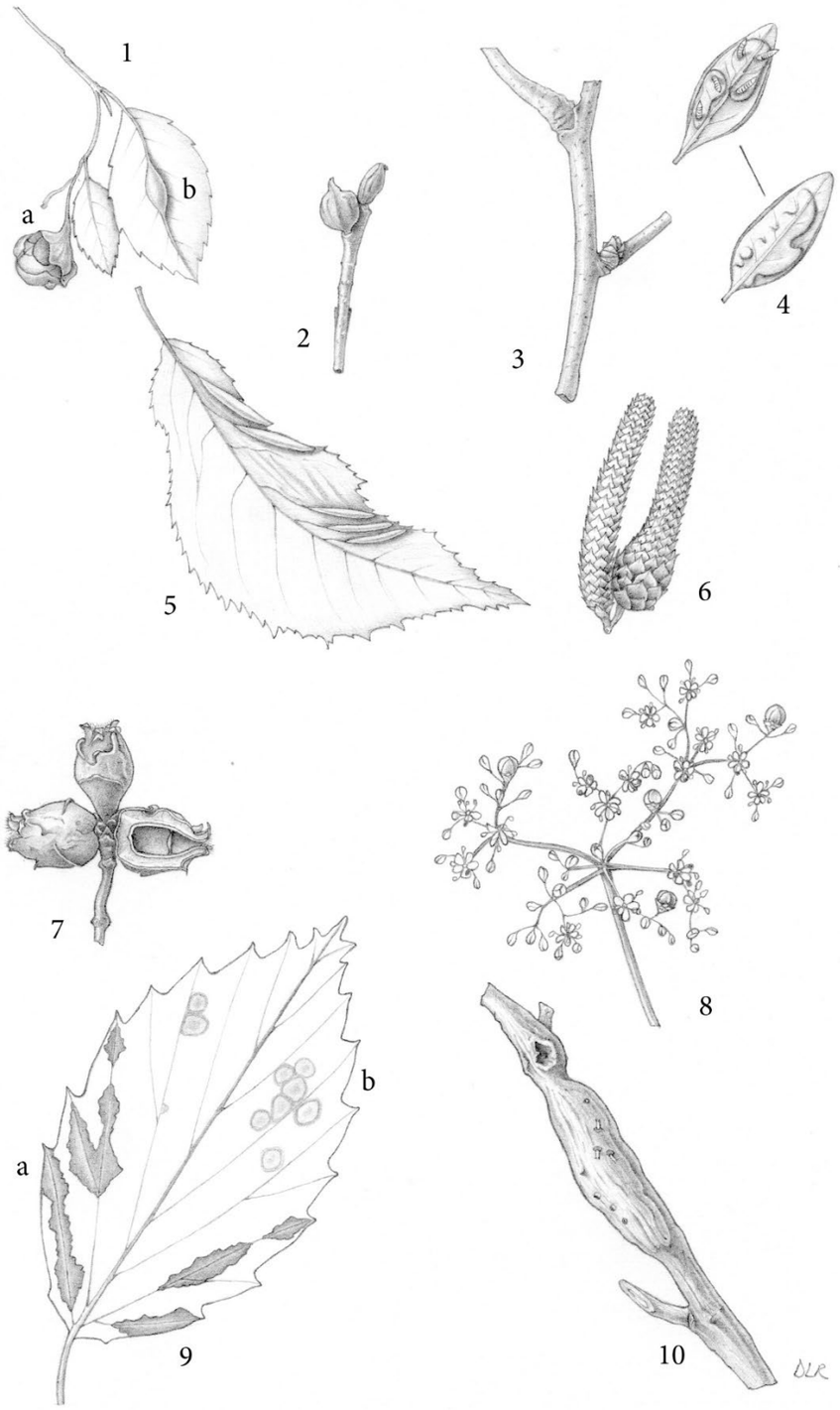


Plate 46. Balsaminaceae, Betulaceae, Buxaceae, Caprifoliaceae and Viburnaceae. **1,** Galls of *Impatiens capensis*: **a,** bud gall: *Schizomyia impatientis*; **b,** midrib swelling: *Neolasioptera impatientifolia*. **2,** Enlarged bud, *Alnus* sp.: *Dasineura serrulatae*. **3,** Swollen bud and base of petiole, *Betula* sp.: *Massalongia papyriferae*. **4,** Leaf blisters, one leaf with pupal skins attached to exit holes, *Buxus* sp.: *Monarthropalpus flavus*. **5,** Swollen leaf veins, *Carpinus caroliniana*: *Dasineura pudibunda*. **6,** Normal and deformed catkin, *Corylus* sp.: *Contarinia squamicola*. 7, Bud galls, one in section, *Lonicera* sp.: *Lonicerae lonicera*. **8**, Enlarged flower buds, *Sambucus canadensis*: *Schizomyia umbellicola*. **9,** Leaf galls, *Viburnum dentatum*: **a,** vein swellings: *Sackenomyia viburnifolia*; **b**, leaf blisters: *Sackenomyia commota*. **10**, Swollen stem, *Viburnum dentatum*: *Neolasioptera viburnicola*. Gagné 1989.

To 8 Gall Keys (Balsaminaceae).
To 8 Gall Keys (Betulaceae).
To 8 Gall Keys (Buxaceae).
To 8 Gall Keys (Caprifoliaceae).
To 8 Gall Keys (Viburnaceae).

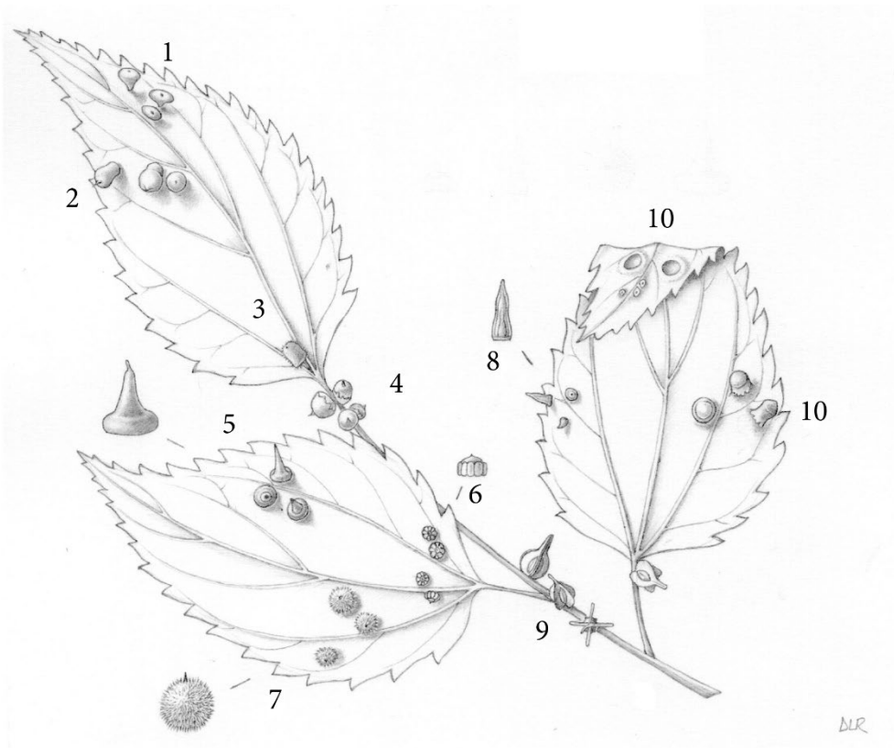


Plate 47. Cannabaceae. Galls on *Celtis*. **1-10.** Twig and leaf galls: *Celticecis* spp.: **1,** *Celticecis wellsi*; **2,** *Celticecis celtiphyllia*; **3,** *Celticecis texana*; **4,** *Celticecis oviformis*; **5,** *Celticecis spiniformis*; **6,** *Celticecis capsularis*; **7,** *Celticecis pubescens*; **8,** *Celticecis subulata*; **9,** *Celticecis semenrumicis*; **10,** *Pachypsylla celtidismamma* (Psocoptera: Psyllidae), galls shown from both leaf surfaces. Gagné 1989.

To 8 Gall Keys (Cannabaceae).

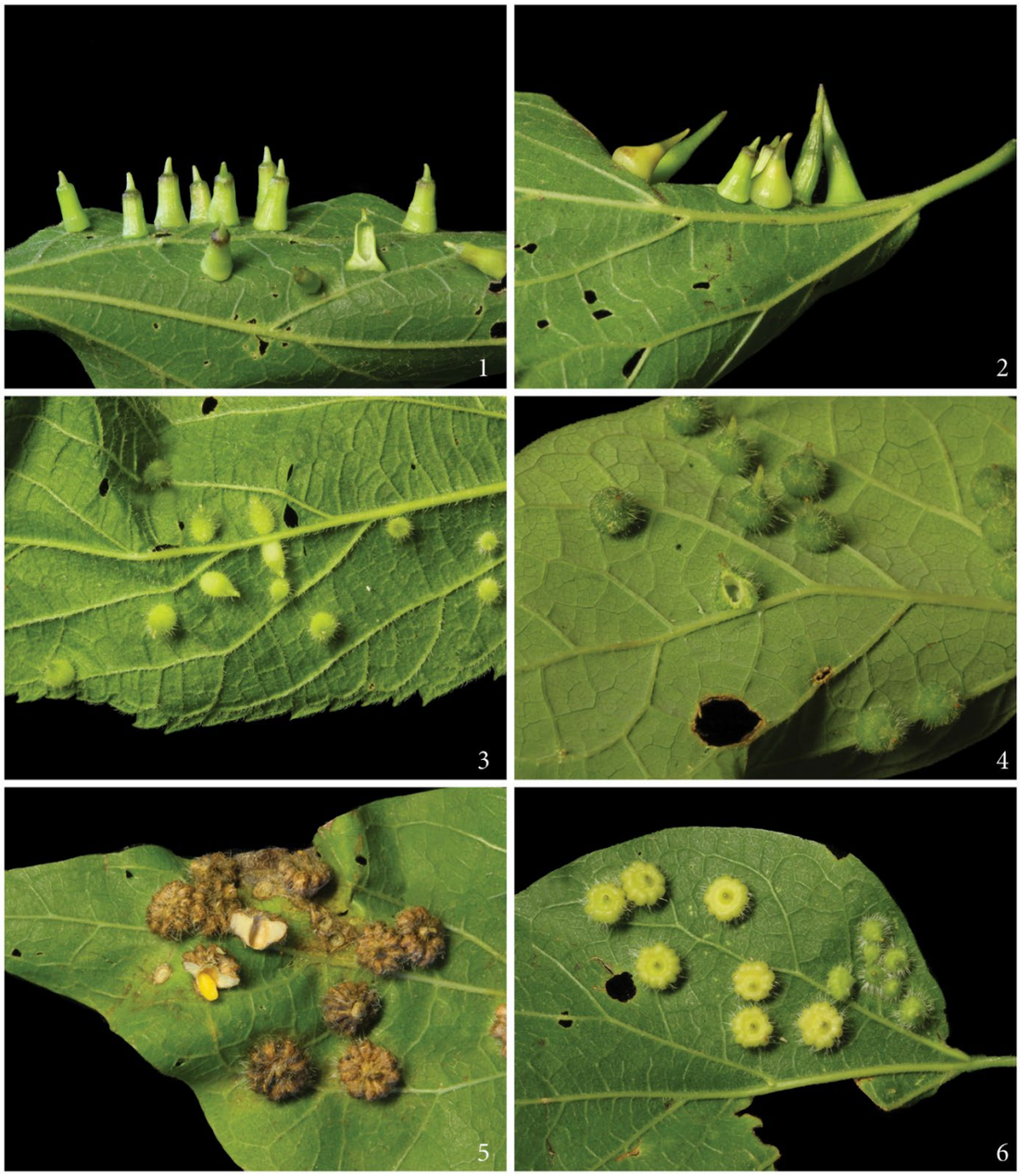


Plate 48. Cannabaceae. **1-6,** *Celticecis* galls. 1, *C. aciculata*, one in section. **2,** Assemblage of *C. aciculata*, *C. spiniformis* and *C. subulata*. **3-4,** *C. acuminata*: **3,** young galls; **4,** mature galls, one in section with third instar. **5-6,** *C. capsularis*: **5,** mature galls, one in section; **6,** young galls. All figures 2x actual size. Gagné and Moser 2013.

To 6 Plant Galls.
To 8 Gall Keys (Cannabaceae).

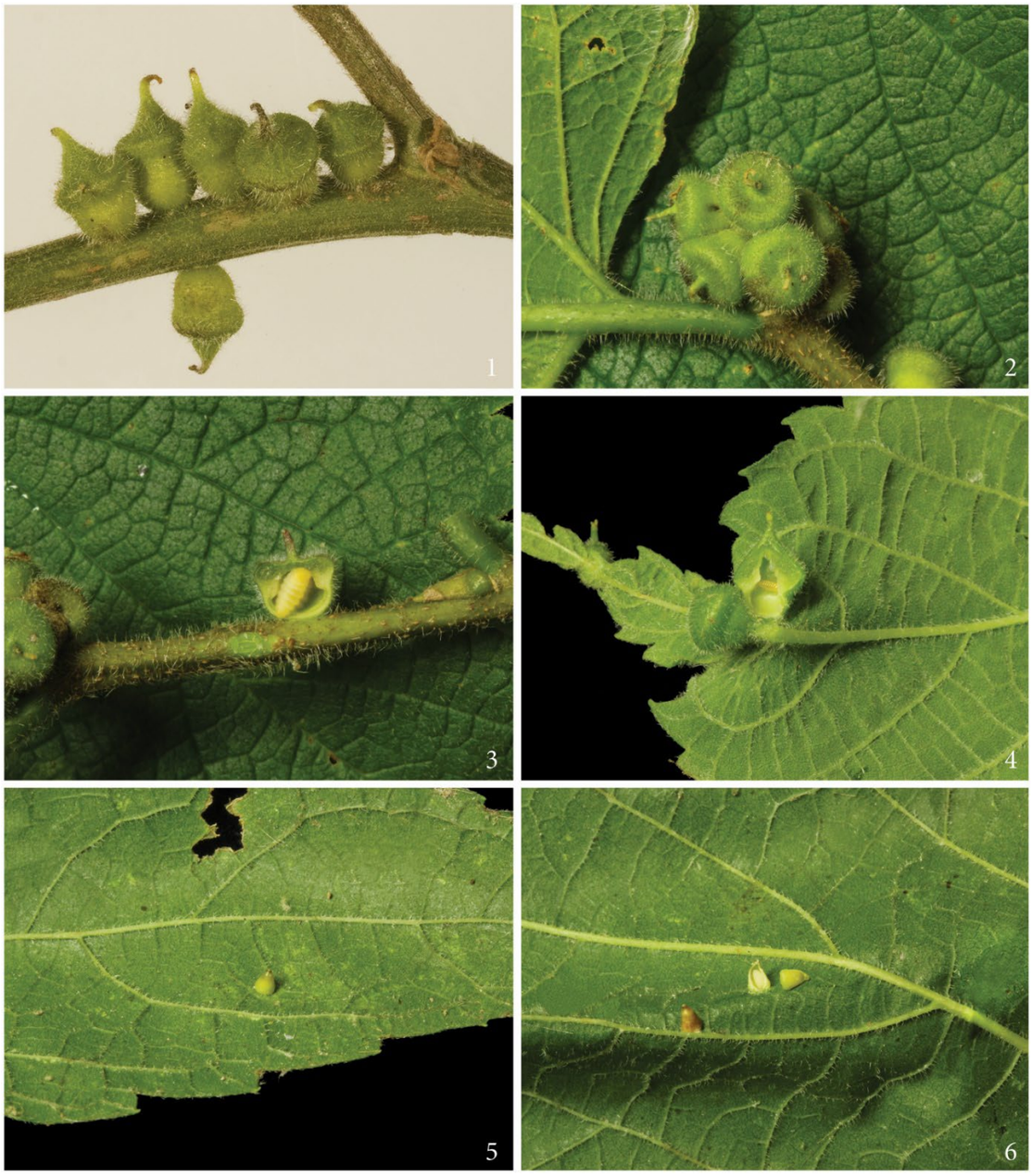


Plate 49. Cannabaceae. **1-6,** *Celticecis* galls. **1-4,** *C. celtiphyllia*: **3,** mature gall in section with third instar; **4,** young gall in section with second instar. **5-6,** *C. conica*: **6,** gall in section with third instar. All figures 2x actual size. Gagné and Moser 2013.

To 8 Gall Keys (Cannabaceae).

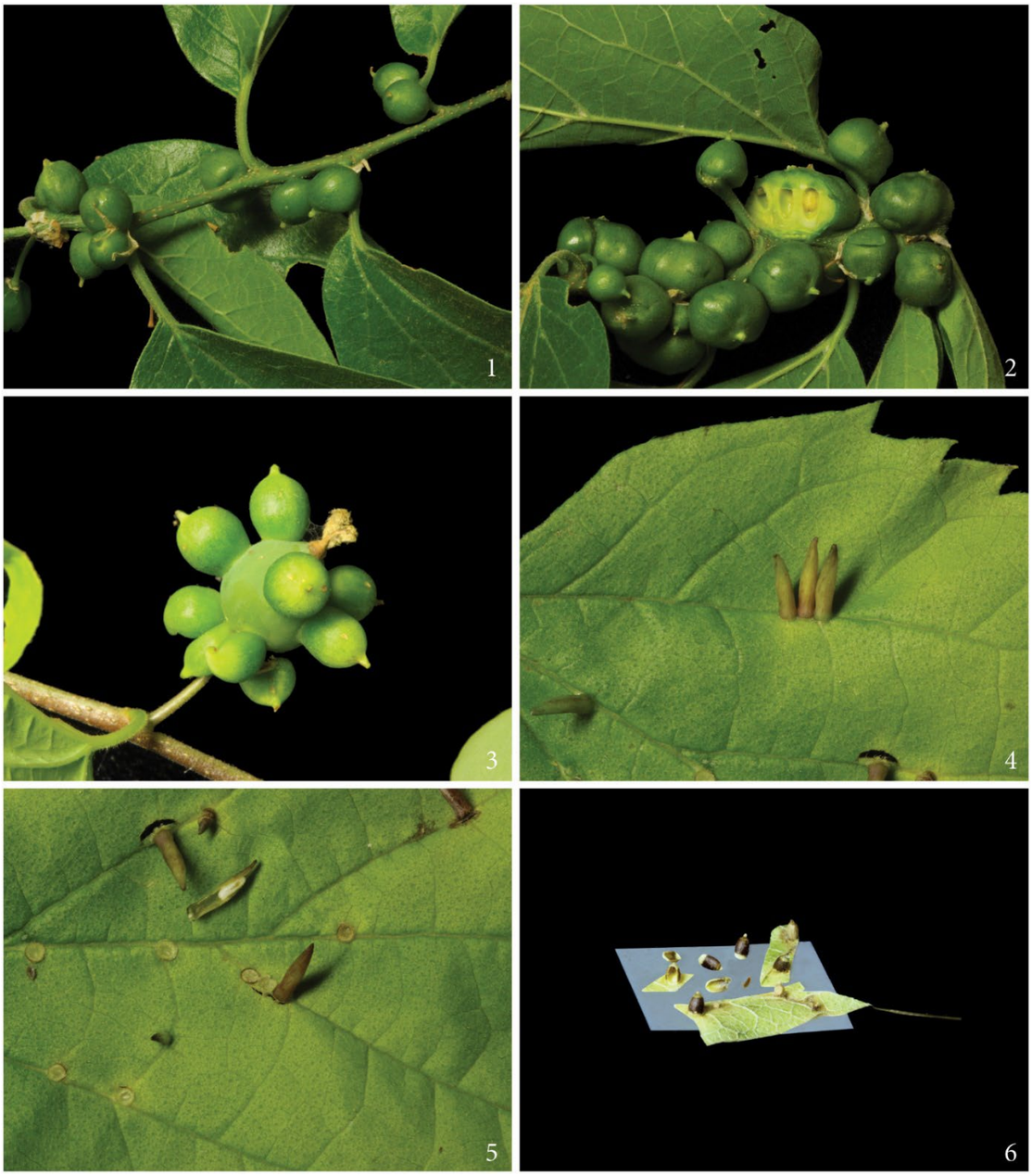


Plate 50. Cannabaceae. **1-6,** *Celticecis* galls. **1-3,** *C. connata*: **2,** one in section with third instars; **3,** galls on fruit. **4-5,** *C. cornuata*: **5,** one in section with third instar, note pads left on veins after galls have dropped. **6,** *C. cupiformis* with examples in section. All figures 2x actual size. Gagné and Moser 2013.

To 8 Gall Keys (Cannabaceae).

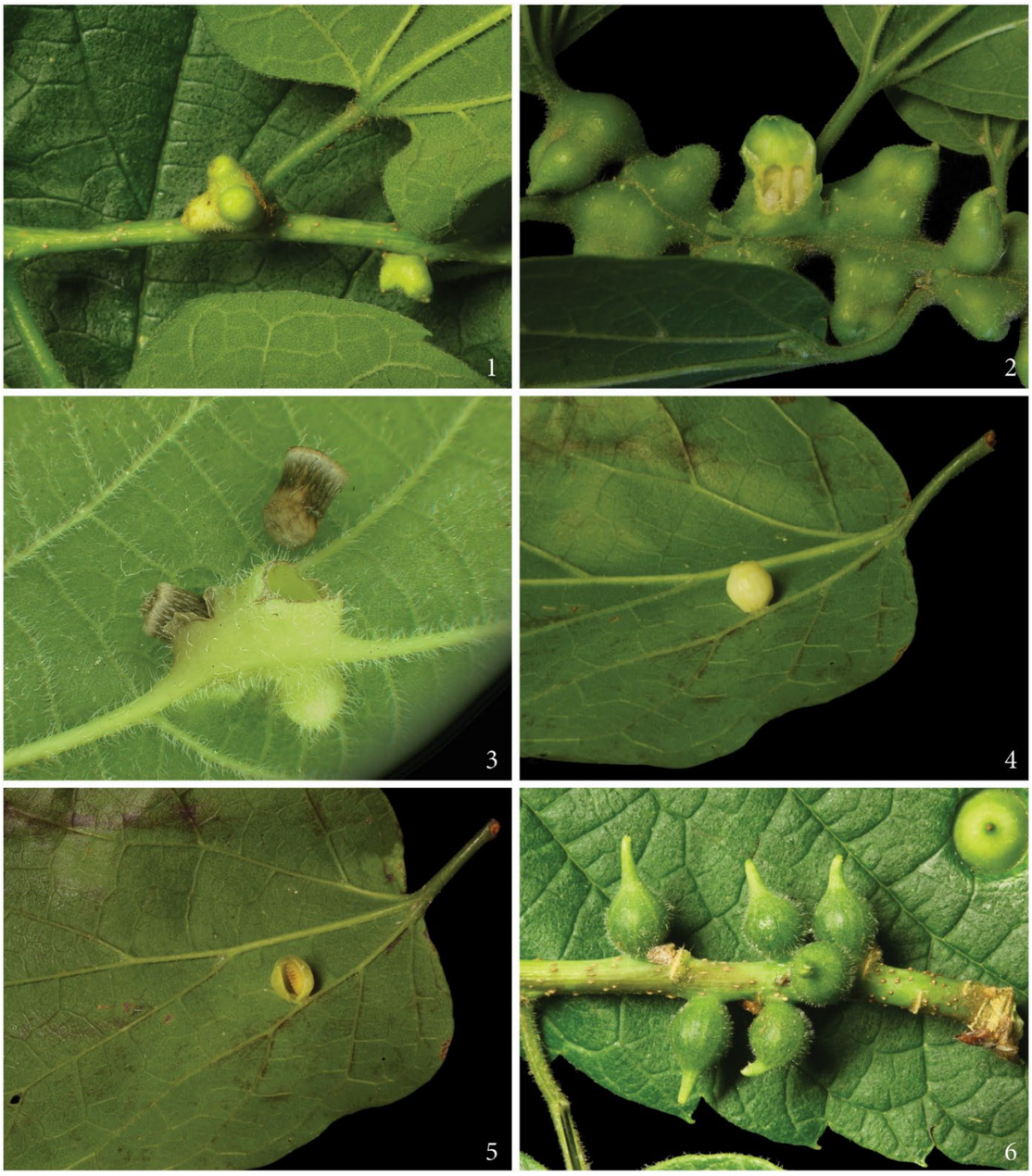


Plate 51. Cannabaceae. **1-6,** *Celticecis* galls. **1-3,** *C. expulsa*: **1,** young galls; **2,** one aggregate gall in section with plugs forming; **3,** dehiscent mature galls. **4-5,** *C. globosa*: 5, gall in section with third instar. **6,** *C. ovata*, with psyllid gall at upper right. All figures 2x actual size. Gagné and Moser 2013.

To 8 Gall Keys (Cannabaceae).

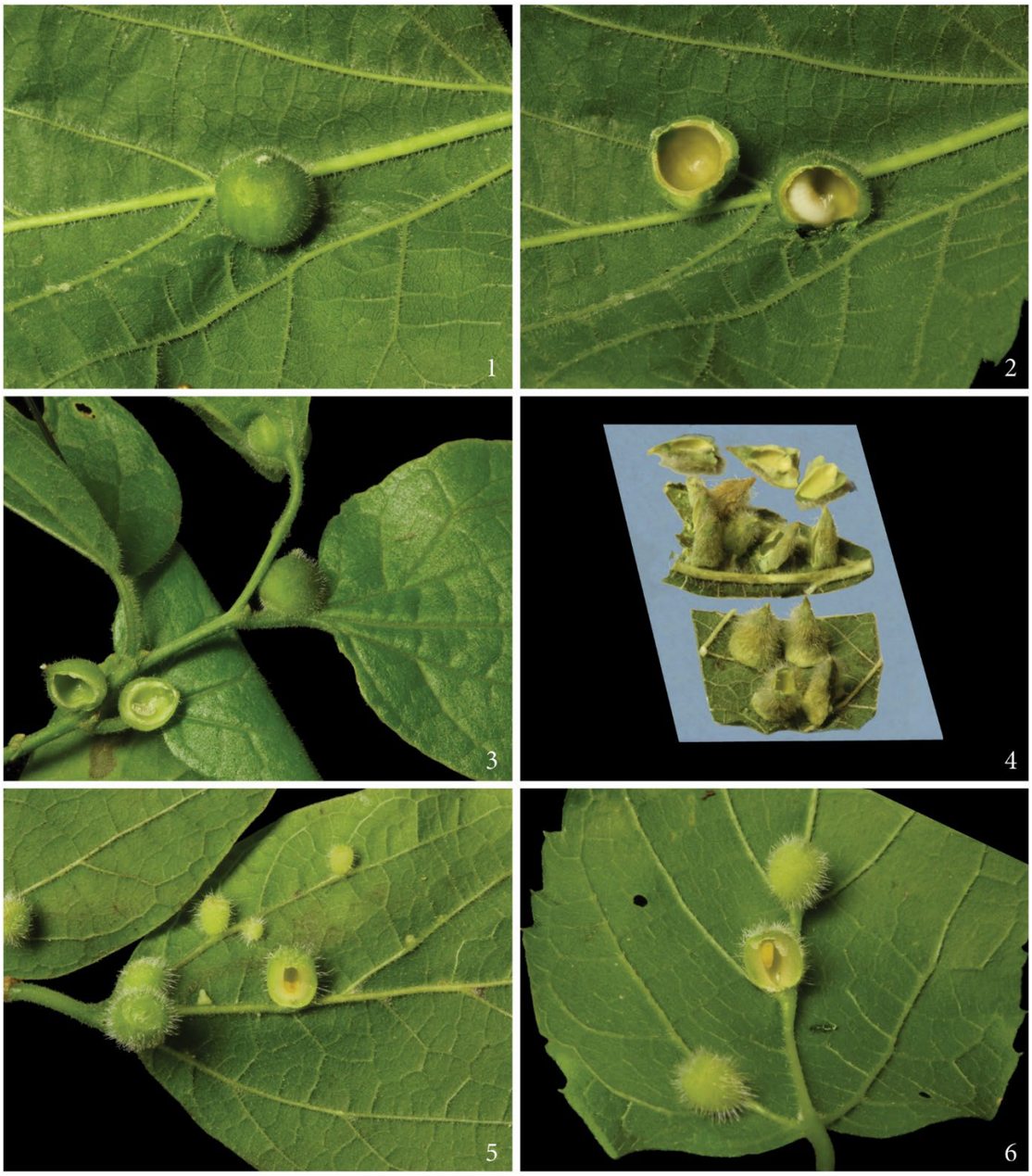


Plate 52. Cannabaceae. **1-6,** *Celticecis* galls. **1-3,** *C. oviformis*: **2,** in section with third instar; **3,** young galls, one in section with second instar. **4,** *C. pilosa* with examples in section. **5-6,** *C. pubescens*: **5,** galls of various ages, one in section with third instar; **6,** mature galls, one in section with third instar. All figures 2x actual size.

To 8 Gall Keys (Cannabaceae).

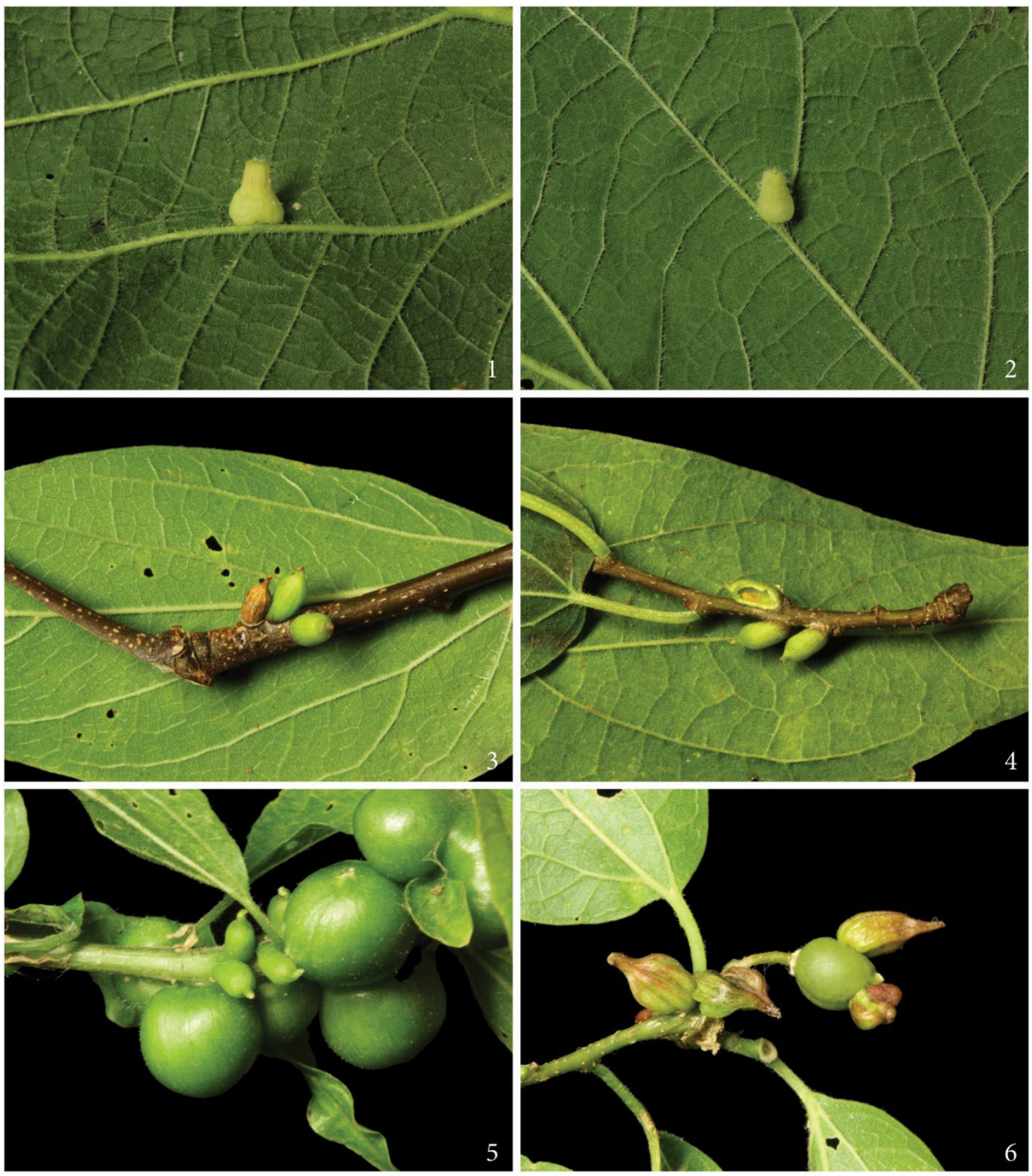


Plate 53. Cannabaceae. **1-6,** *Celticecis* galls. **1-2,** *C. pyriformis*. **3-4,** *C. ramicola*: **4,** one in section with second instar. **5,** Assemblage of *C. ramicola* and *C. connata*. **6,** *C. semenrumicis*, young galls, two growing from fruit. All figures 2x actual size. Gagné and Moser 2013.

To 8 Gall Keys (Cannabaceae).

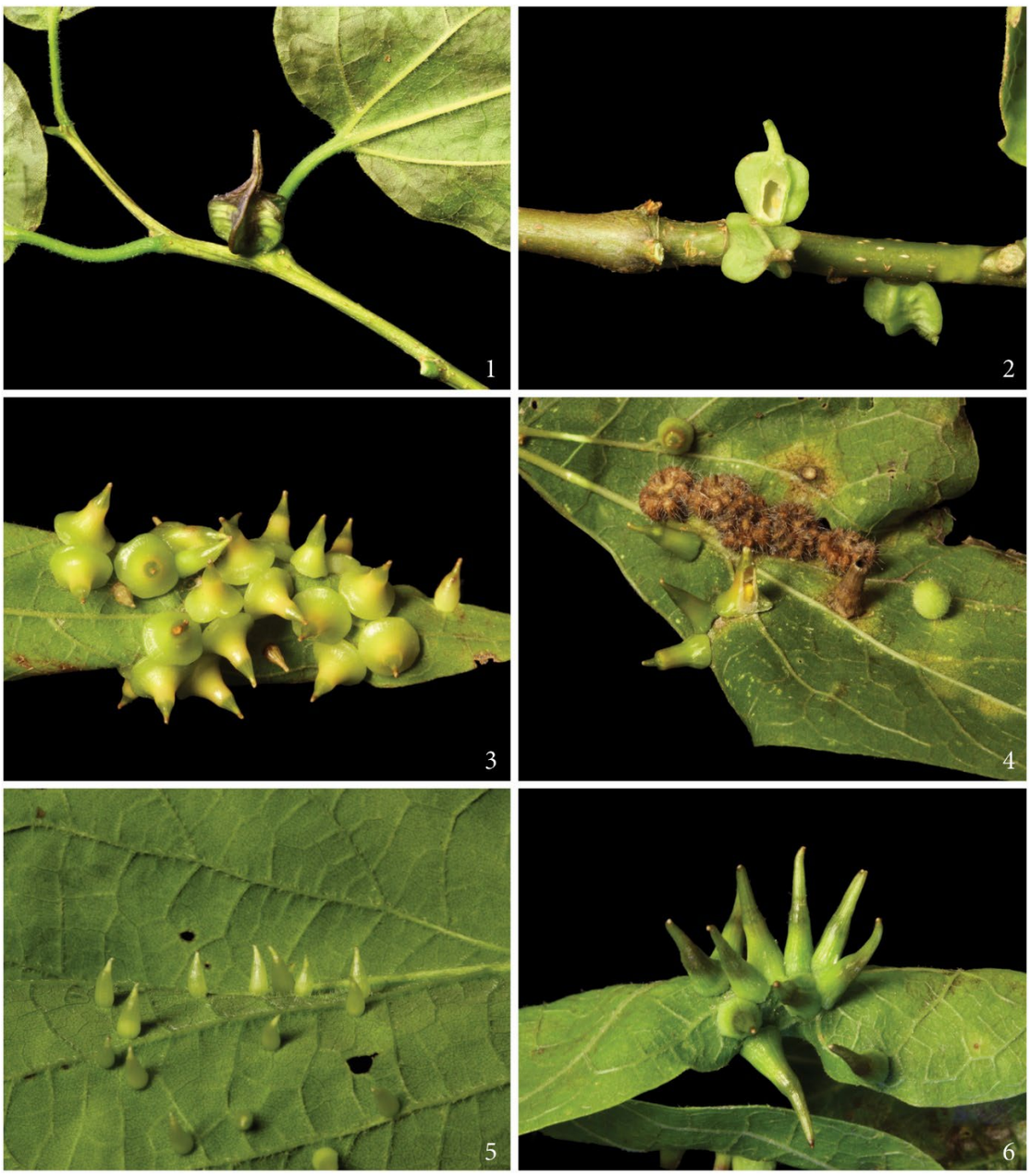


Plate 54. Cannabaceae. **1-6,** *Celticecis* galls. **1-2,** *C. semenrumicis*: **2,** one in section. **3,** C. *spiniformis*. **4,** Assemblage of *C. spiniformis* (gall in center, sectioned, showing cocooned third instar), *C. aciculata*, *C. capsularis* and *C. globosa*. **5,** *C. spiniformis*, young galls. **6,** *C. subulata*. All figures 2x actual size. Gagné and Moser 2013.

To 8 Gall Keys (Cannabaceae).

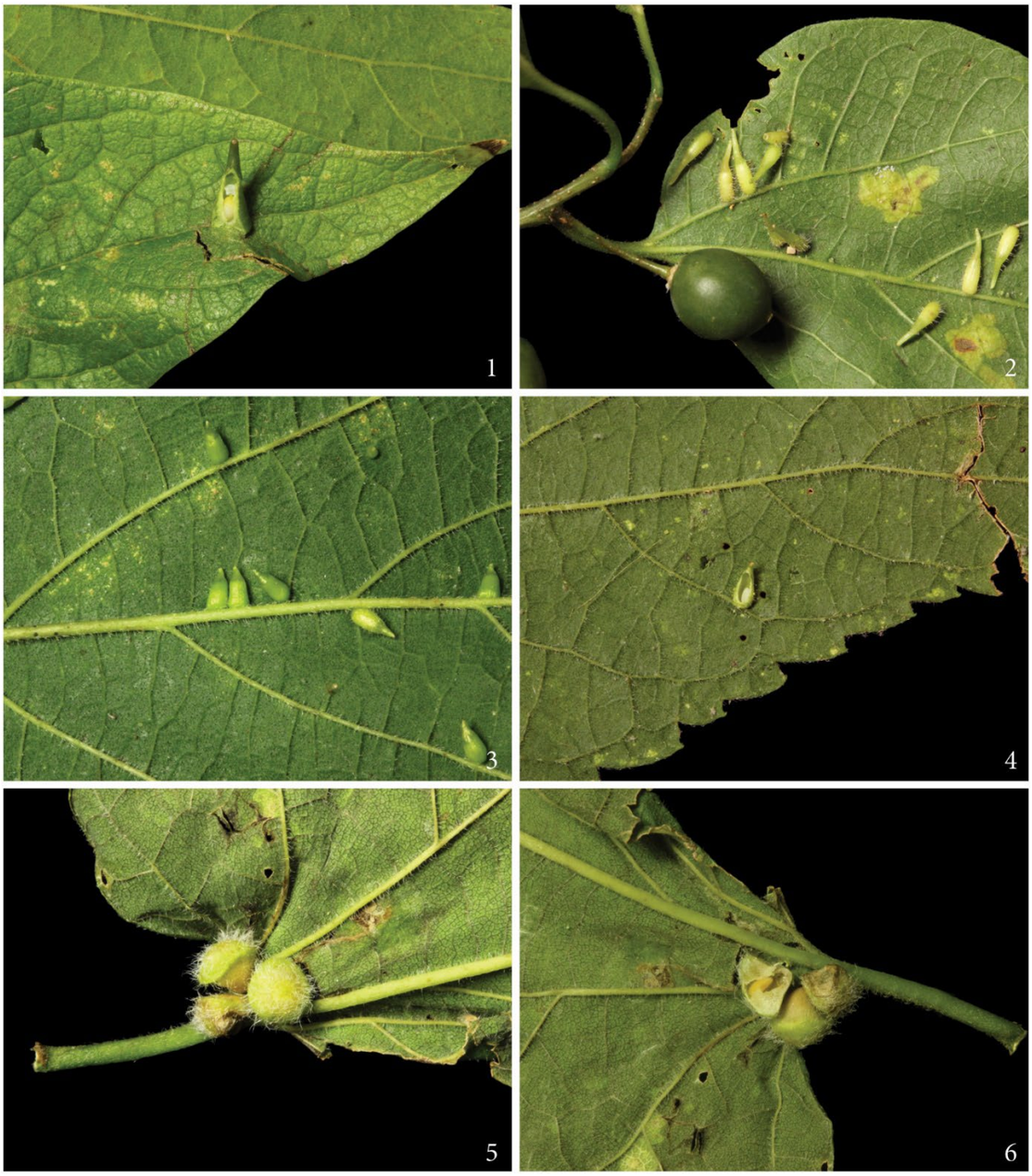


Plate 55. Cannabaceae. **1-6,** *Celticecis* galls. **1,** *C. subulata*, gall in section with cocooned third instar. **2-4,** *C. supina*: **4,** gall in section with third instar. **5-6,** *C. wellsi*: **6,** gall in section with third instar. All figures 2x actual size. Gagné and Moser 2013.

To 8 Gall Keys (Cannabaceae).

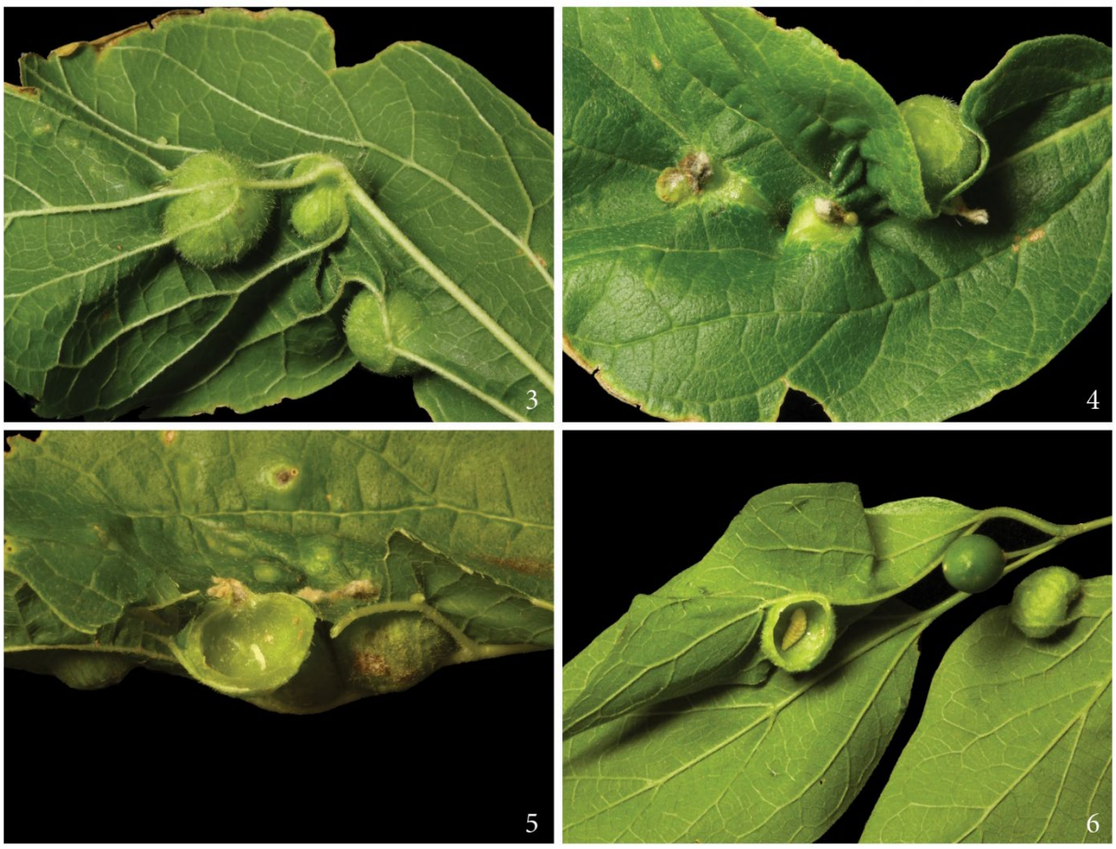


Plate 56. Cannabaceae. **1-4,** *Peracecis fugitiva* galls: **1,** lower leaf surface. **2,** upper leaf surface showing escape chimney; **3,** gall in longitudinal section; **4,** gall in cross section, with third instar. All figures 2x actual size. Gagné and Moser 2013.

To 8 Gall Keys (Cannabaceae).

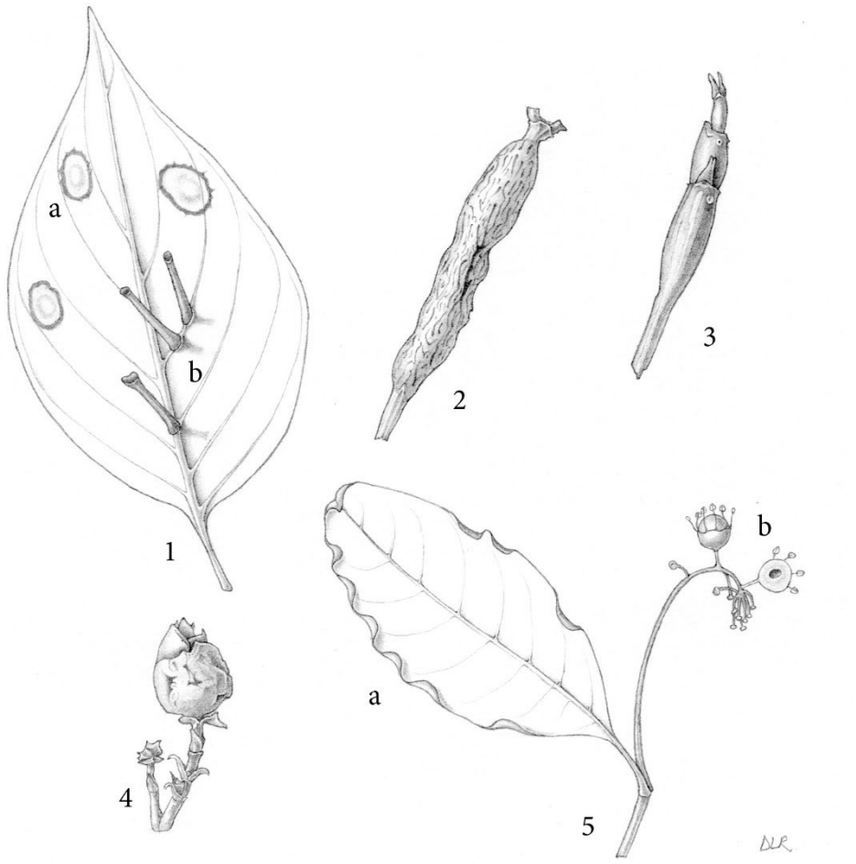


Plate 57. Cornaceae, Garryaceae, Nyssaceae. **1,** Galls of *Cornus sericea*, **a,** leaf spots: *Parallelodiplosis subtruncata*; **b,** leaf tube galls: *Craneiobia tuba*. **2,** Stem swelling, *Cornus racemosa*: *Neolasioptera cornicola.* 3, Clavate stem swelling, *Cornus florida*: *Resseliella clavula*. **4,** Swollen bud, *Garrya buxifolia*: *Asphondylia garryae*. **5,** Galls of *Nyssa sylvatica*, **a,** marginal leaf folds: *Phylloxera nyssae* (Phylloxeridae) and predaceous cecidomyiid *Cartodiplosis nyssaecola*; **b,** Swollen staminate flowers, one in section: *Contarinia* sp. Gagné 1989.

To 6 Plant Galls.
To 8 Gall Keys (Cornaceae).
To 8 Gall Keys (Garryaceae).
To 8 Gall Keys (Nyssaceae).

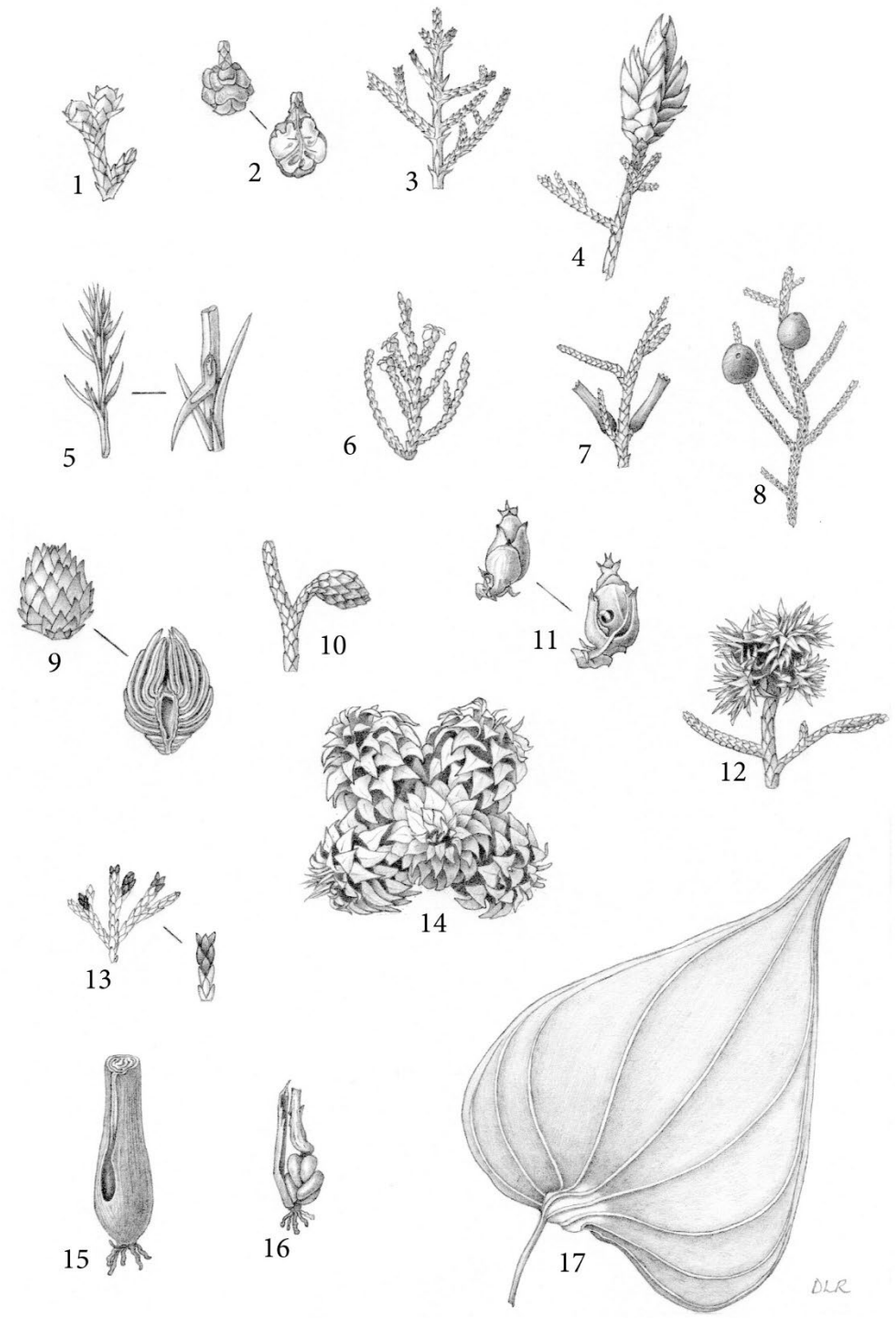


Plate 58. Cupressaceae, Cyperaceae and Dioscoreaceae. **1,** Swollen branchlet, *Callitropsis nootkatensis*: *Chamaediplosis nootkatensis*. **2,** Cones, one with scales removed to show larval chambers, *Chamaecypari**s** lawsoniana*: *Cupressatia siskiyou*. **3,** Branchlet tips, Hesperoc*ypari**s** arizonica*: *Chamaediplosis rugosa*. **4,** Enlarged bud, *Hesperocypari**s** sargentii*: *Walshomyia cupressi*. **5,** Branch swelling, one in 2x showing larval chamber (adapted with permission from Haseman and McLane 1940, Annals of the Entomological Society of America), *Juniperus communis*: *Contarinia juniperina*. **6,** Swollen branchlet tips, *Juniperus scopulorum*: *Oligotrophus* sp. **7,** Deformed fruit, *Juniperus osteosperma*: *Walshomyia* sp. **8,** Deformed fruit, *Juniperus occidentalis*: *Walshomyia* sp. **9,** Enlarged bud, one sectioned to show larval chamber, *Juniperus occidentalis*: *Walshomyia* sp. **10,** Enlarged bud (redrawn from White 1950, courtesy of University of Texas Press), *Juniperus ashei*: *Oligotrophus pattersoni*. **11,** Cones, one with some scales removed to show larva in chamber, *Thuja plicata*: *Cupressatia thujae*. **12,** Enlarged, burrlike bud, *Juniperus* sp.: *Oligotrophus juniperi*. **13,** Swollen, discolored branchlet tips, *Juniperus virginiana*: *Oligotrophus betheli*. **14,** Enlarged buds with recurved bracts, *Juniperus osteosperma*: *Walshomyia* sp. **15,** Swollen stem base, partially cut open to reveal a larval chamber, *Carex* sp.: *Planetella* sp. **16,** Ovoid swelling at base of stem, *Carex* sp.: *Planetella* sp. 273, Basal leaf swelling, *Dioscorea villosa*: *Neolasioptera* sp. Gagné 1989.

To 8 Gall Keys (Cupressaceae).
To 8 Gall Keys (Cyperaceae).
To 8 Gall Keys (Dioscoreaceae).

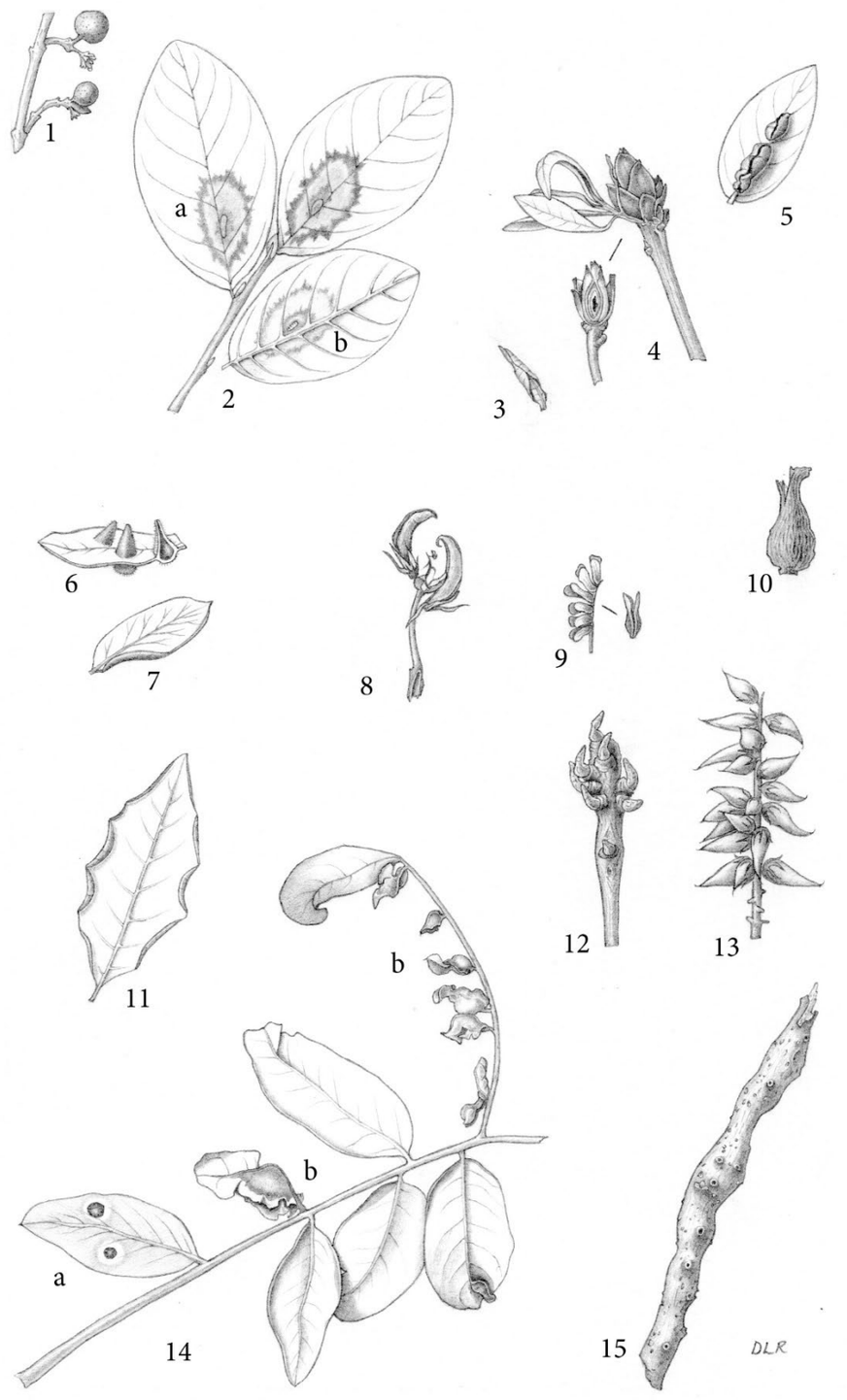


Plate 59. Eleagnaceae, Ericaceae and Fabaceae. **1,** Enlarged flower bud, *Shepherdia canadensis*: *Asphondylia shepherdiae*. **2,** Leaf spots, **a** from above, **b** from below showing larva, *Vaccinium* sp.: *Contarinia* sp. **3,** Rolled leaf, *Vaccinium* sp.: *Dasineura cyanococci*. **4,** Enlarged leaf bud, *Rhododendron periclymenoides*: *Asphondylia azaleae*. **5,** Succulent midrib fold, *Vaccinium* sp.: *Vaccinidiplosis vaccinii*. **6,** Leaf cone galls, *Amorpha canescens*: *Rhopalomyia* sp. (redrawn from Wells 1921b). **7,** Marginal leaf roll, *Amorpha canescens*: cecidomyiid (redrawn from Wells 1921b). **8,** Deformed, aborted pods, *Cyamopsis tetragonoloba*: *Asphondylia websteri*. **9,** Joined, swollen leaflets, *Acacia greggii*: *Contarinia* sp. **10,** Modified leaflets, *Desmodium* sp.: *Dasineura meibomiae*. **11,** Marginal leaf rolls, *Robinia pseudoacacia*: *Obolodiplosis robiniae*. 1**2,** Persistent bud galls, *Neltuma glandulosa*: *Asphondylia* sp. **13,** Flower galls, *Neltuma glandulosa*: *Hemiasphondylia prosopidis*. **14,** Leaflet galls, *Gleditsia triacanthos*: **a,** leaf blisters: *Meunieriella aquilonia*; **b,** leaf folds,: *Dasineura gleditchiae*. **15,** Swollen stem, *Gleditsia triacanthos*: *Neolasioptera brevis*. Gagné 1989.

To 8 Gall Keys (Elaeagnaceae).
To 8 Gall Keys (Ericaceae).
To 8 Gall Keys (Fabaceae).

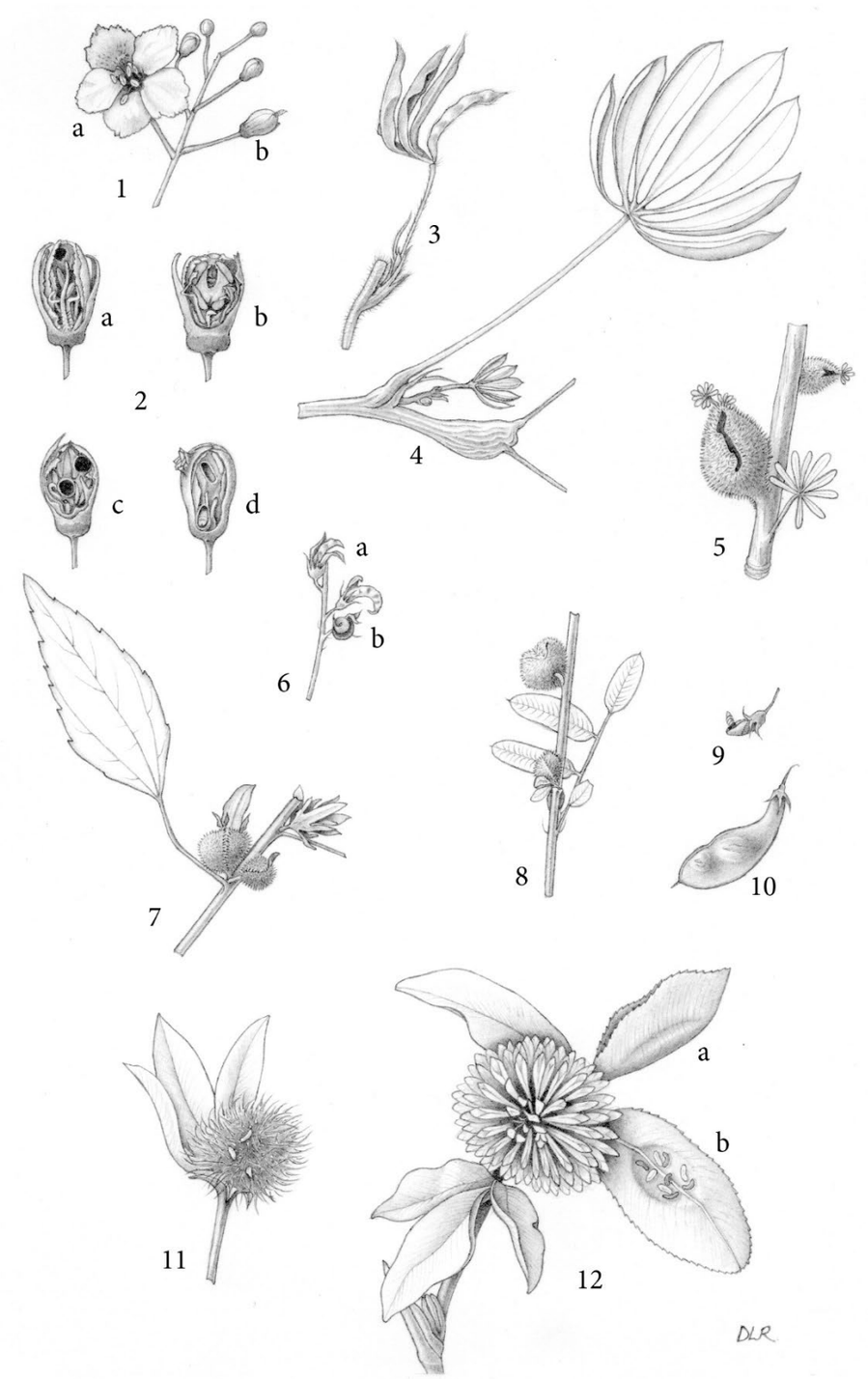


Plate 60. Euphorbiacae and Fabaceae. **1,** *Parkinsonia aculeata*: *Asphondylia websteri*: **a,** normal flower; **b,** aborted flower with pupa emerging. **2,** Injured, sectioned flower buds (2x), *Parkinsonia aculeata*: *Asphondylia websteri*: **a,** with pupal chamber at top; **b,** chamber opened to show pupa, **c,** with two spherical chambers of *Tetrastichus* (Hymenoptera), an inquiline; **d,** with two larval *Asphondylia* chambers. **3,** Rolled leaves, *Lupinus* sp.: *Dasineura lupinorum*. **4,** Swollen petiole and stem (redrawn from Russo 1979, courtesy of The Boxwood Press), *Lupinus arboreus*: *Neolasioptera lupini*. **5,** Swollen bud, *Lupinus arboreus*: *Dasineura lupini*. **6,** Pod galls: Medicago sativa: *Asphondylia websteri*: **a,** infested pods; **b,** normal, curled pods. **7,** Bud galls, *Acalypha rhomboidea*: *Resseliella globosa*. **8,** Bud galls, *Lespedeza violacea*: cecidomyiid. **9, 10,** Pod galls, *Rhynchosia texana*: *Asphondylia* sp. **11,** Larvae on flower head, *Trifolium repens*: *Dasineura leguminicola* (after photograph in Barnes 1946b). **12,** Swollen, folded leaflet, *Trifolium repens*: *Dasineura trifolii* (redrawn from Forbes 1909): **a,** folded leaf gall, **b,** one pulled open to show larvae. Gagné 1989.

To 8 Gall Keys (Euphorbiaceae).
To 8 Gall Keys (Fabaceae).

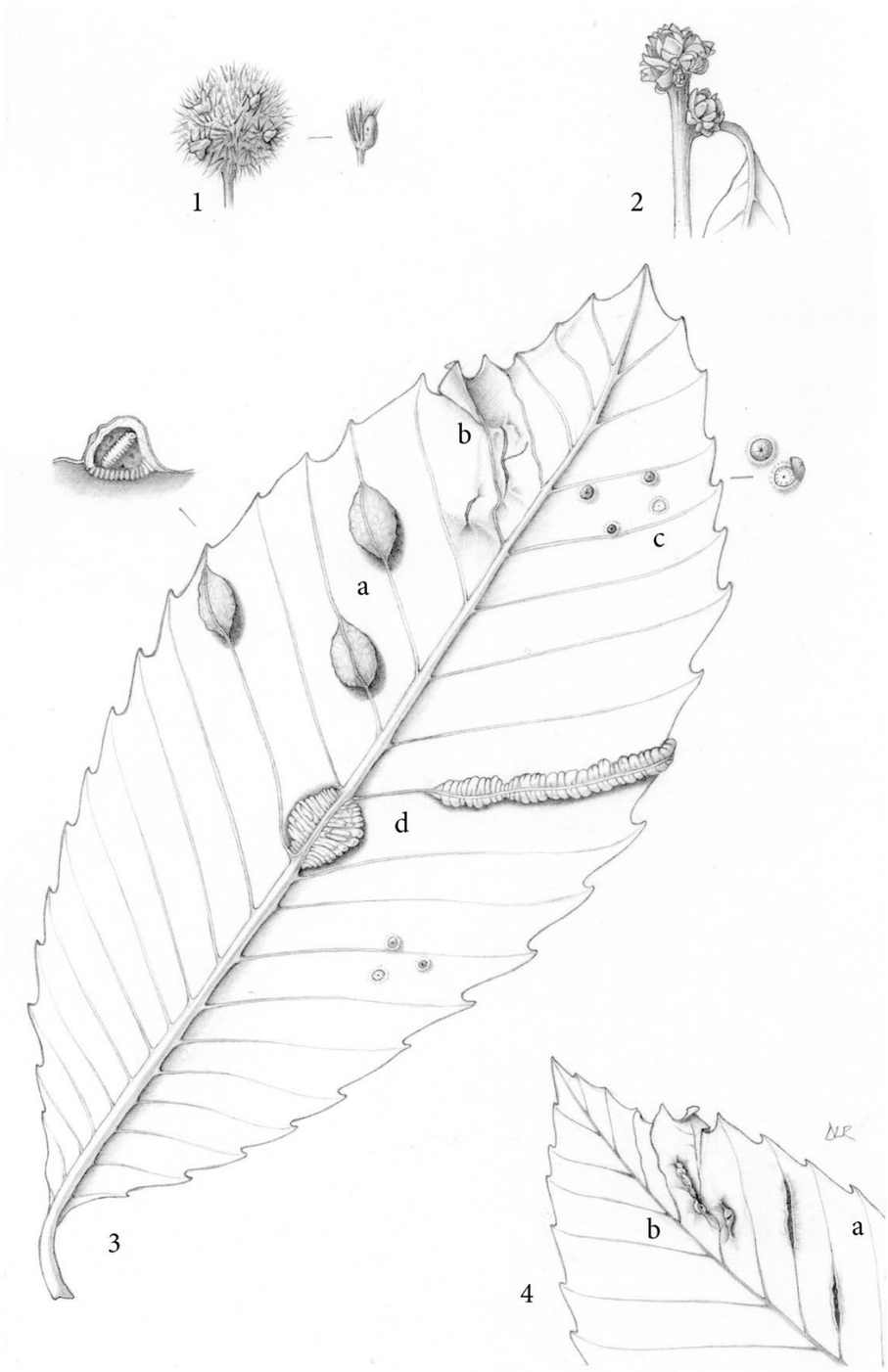


Plate 61. Fagaceae. *Castanea* spp. **1,** Husk swellings, one in 2x, *C. pumila*: "*Cecidomyia*" *chinquapin*. **2,** Swollen, clustered buds, *C. dentata*: *Arnoldiola castaneae*. **3, 4,** Leaf galls, *C. dentata*: **3,** Lower surface of leaf, **4,** upper surface; **a,** vein folds, with enlarged cross section in side view: *Macrodiplosis castaneae*: **b,** leaf blade folds: *Contarinia* sp.; **c,** capsule galls, two in 2x, one with cap partially separated: *Dasineura dentatae*; **d,** ribbed vein folds, *Harmandiola amisae*. Gagné 1989.

To 8 Gall Keys (Fagaceae).

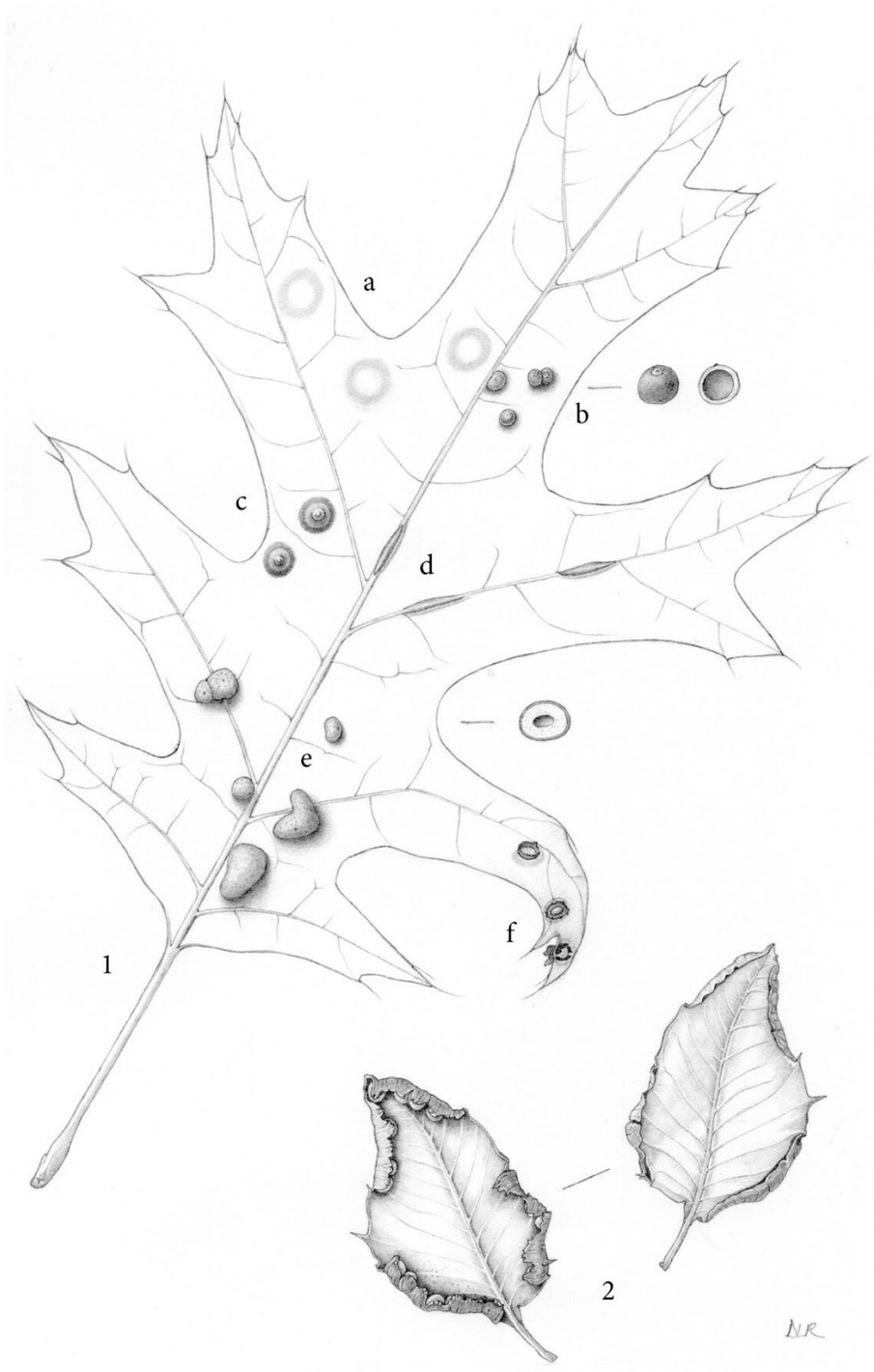


Plate 62. Fagaceae: *Quercus* spp. **1,** Leaf galls, *Q. rubra*, upper leaf surface: **a,** simple leaf spots: *Polystepha quercifolia*; **b,** thin-walled, spherical galls, with examples in 2x, one sectioned: *Polystepha globosa*; **c,** nippled blister galls: *Polystepha* ?*sobrina*; **d,** vein swellings: *Polystepha americana*; **e,** hard, woody galls, with enlarged section in 2x: *Polystepha pilulae*; **f,** hard, woody gall with dehiscent outer skin, visible on both sides of leaf: *Polystepha symmetrica*. **2,** Rolled leaf margins, lower surface on left, upper on right: *Q. chrysolepis*: "*Dasineura*" *sylvestrii*. Gagné 1989.

To 8 Gall Keys (Fagaceae).

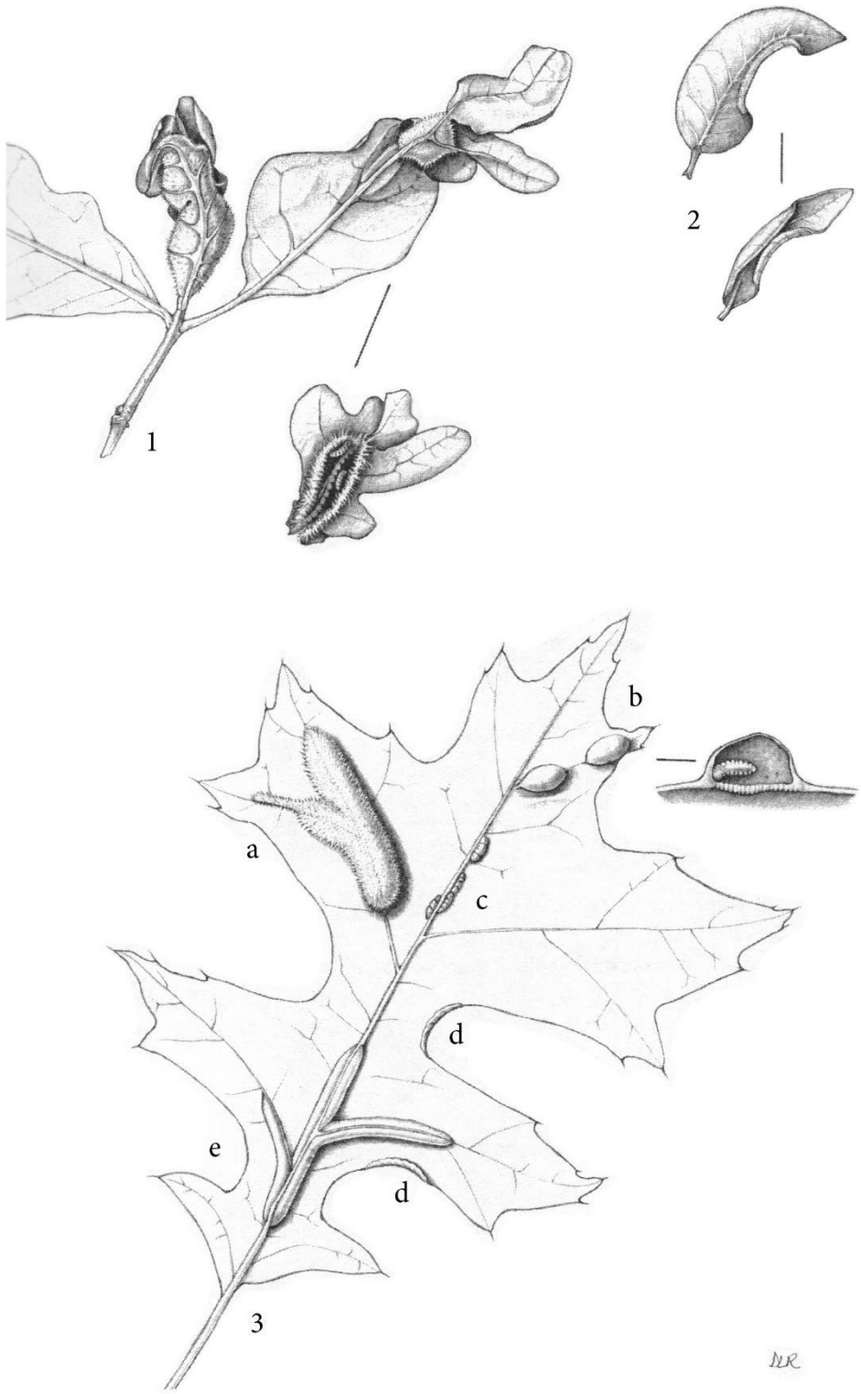


Plate 63. Fagaceae: *Quercus* spp. **1,** Vein fold galls, lower surface on left, upper surface, opened to show larvae, on right, *Q. alba*: *Macrodiplosis niveipila*. **2,** Marginal leaf rolls, lower leaf surface on left, upper on right, *Q. vaccinifolia*: *Contarinia* sp. **3,** Leaf galls, *Q. rubra*, lower leaf surface: **a,** hairy vein pocket: *Macrodiplosis* ?*niveipila*; **b,** smooth, thin-walled pocket with lateral cross section in 2x showing larva: *Macrodiplosis majalis*; **c,** short, striate vein pocket: *Contarinia* sp.; **d,** marginal leaf roll: *Macrodiplosis erubescens*; **e,** smooth vein pocket: *Macrodiplosis qoruca*. Gagné 1989.

To 8 Gall Keys (Fagaceae).

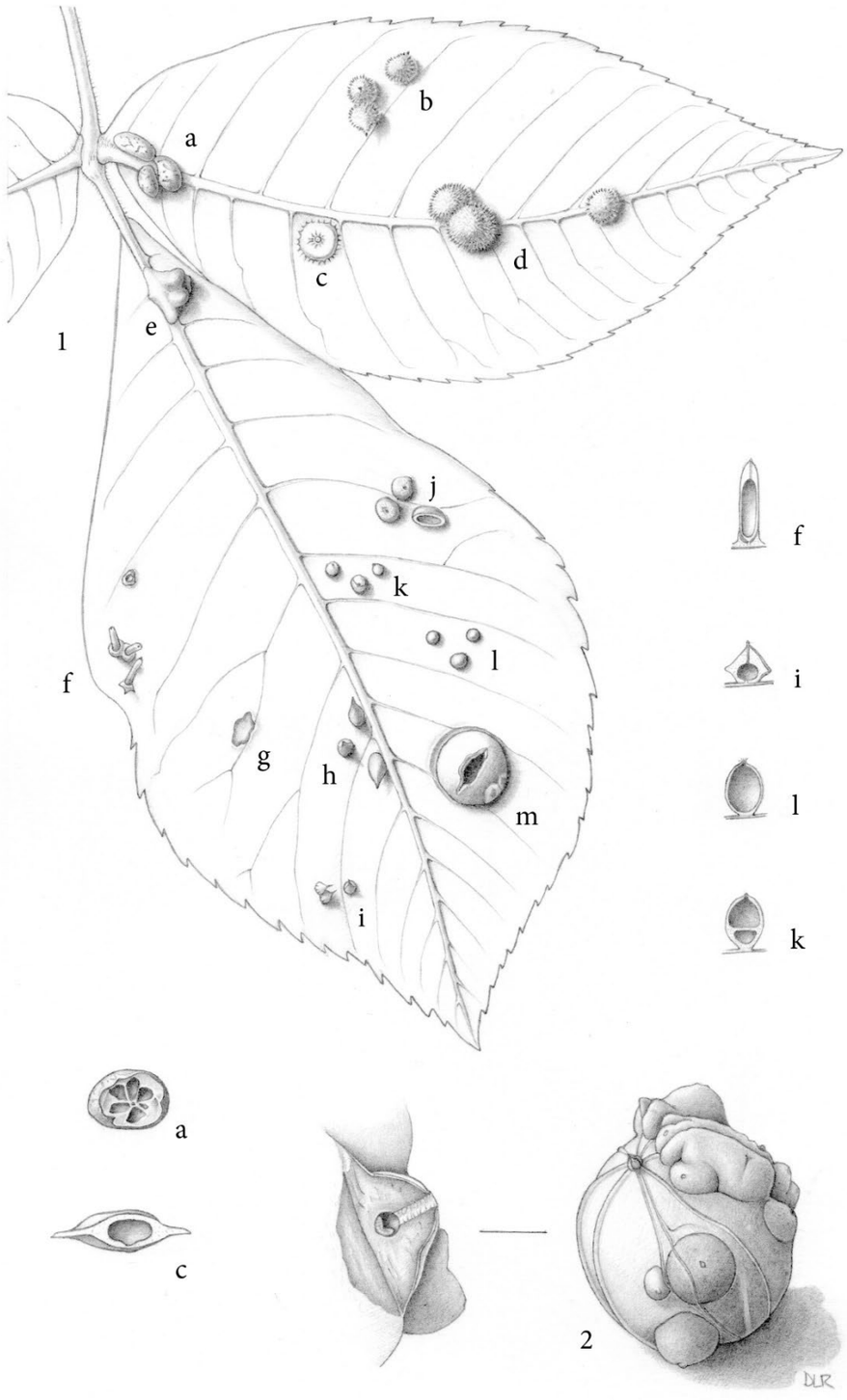


Plate 64. Juglandaceae. Galls of *Carya*: **1,** Galls on lower side of leaflets, examples of some drawn also in 2x section: **a,** smooth, spherical galls, one in section: *Caryomyia cynipsea*; **b,** hairy, onion-shaped galls: *Caryomyia holotricha*; **c,** flat, dimpled blister gall, one in section: *Caryadiplosis biconvexa*; **d,** downy, spherical galls: *Caryomyia persicoides*; **e,** vein swelling of *Phylloxera* sp. (Phylloxeridae); **f,** cylindrical detachable galls, one in section: *Contarinia tubicola*; **g,** leaf spot of *Gliaspilota glutinosa*; **h,** smooth, onion-shaped galls: *Caryomyia caryaecola*; **i,** smooth, pyramidal galls, one in section: *Caryomyia sanguinolenta*; **j,** smooth, depressed-spherical galls, one in section: *Caryomyia thompsoni*; **k,** smooth, spherical galls, one in section: *Caryomyia inanis*; **l,** spheroidal, nippled galls: *Caryomyia caryae*; **m,** leaf blade gall: *Phylloxera* sp. (Phylloxeridae). **2,** Husk swellings, one in 2x section to show larval chamber and escape passage: *Harmandiola nucicola*. Gagné 1989.

To 8 Gall Keys (Juglandaceae).

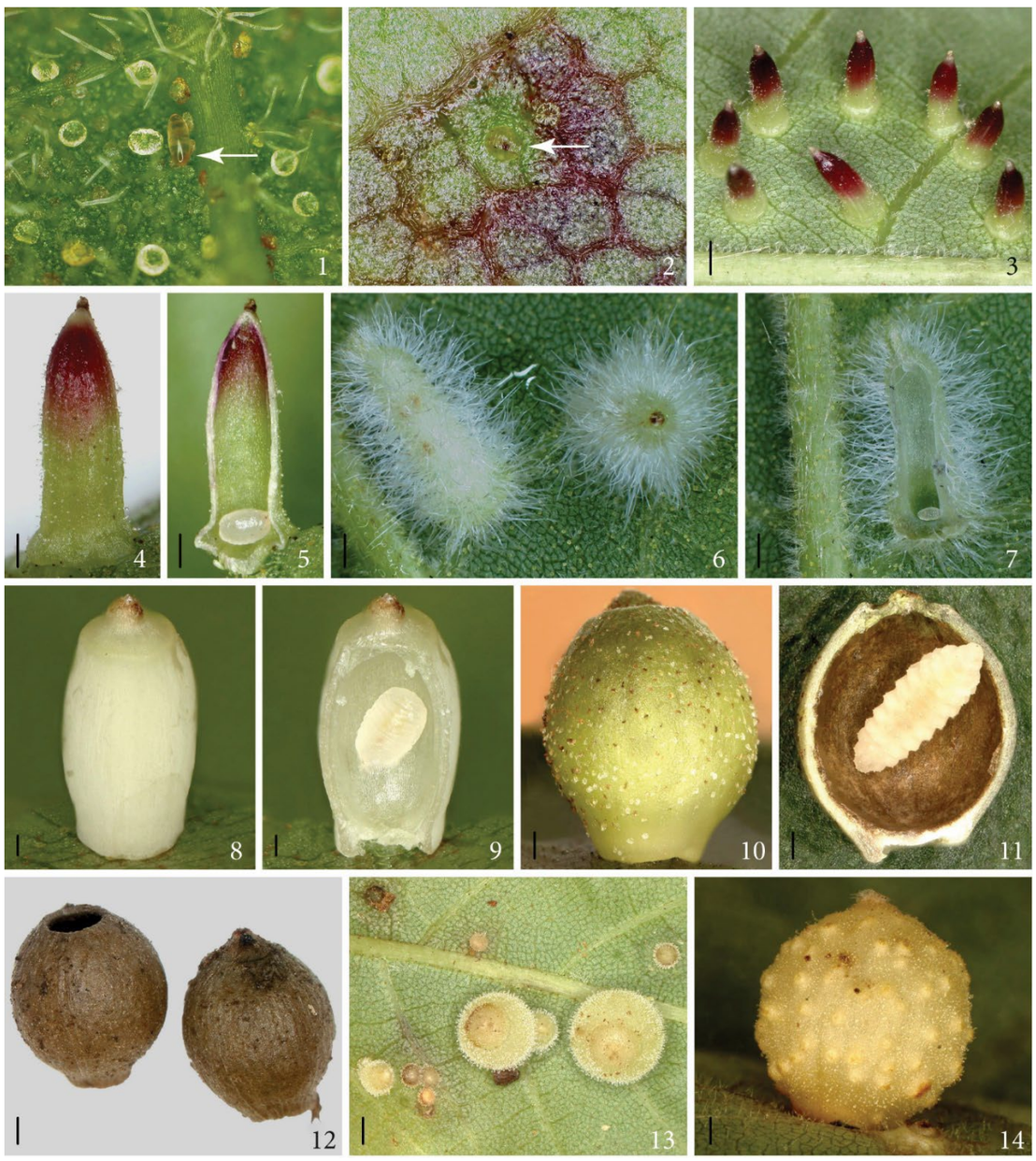


Plate 65. Juglandaceae. Galls of *Carya*. **1-14.** Galls of *Caryomyia* spp., entire and in longitudinal section. **1-5,** *Caryomyia striolata*: **1,** egg on leaflet (globules are resinous exudates); **2,** first instar initiating gall; **5,** with second instar. **6-7,** *C. albipilosa*: **7,** with second instar. **8-9,** *C. urnula*: **9** with second instar. **10-12,** *C. viscidolium*: **11** with third instar; **12,** overwintered galls, one with detached apical cap. **13-14,** *C. tuberidolium*: **13,** young, rapidly growing galls, thickly covered with resin gland exudates. Lines indicate approximate length of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

Plate 66. Juglandaceae. Galls *Carya*. **1-12**. Galls of *Caryomyia* spp., entire or in longitudinal section. **1,** *C. tuberidolium*, with second instar of inquiline *Parallelodiplosis caryae* preyed upon by early instar *Lestodiplosis* sp. **2-3**, *C. hirtidolium*. **4-5**, C. *cilidolium*. **6-7**, *C. hirtiglobus*: **6** with larva of *Lestodiplosis* sp. near base. **8-11,** *C. caryae*: **8-9,** weak-walled form; **10-11,** robust form. **12,** *C. shmoo*. Lines indicate approximate length of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

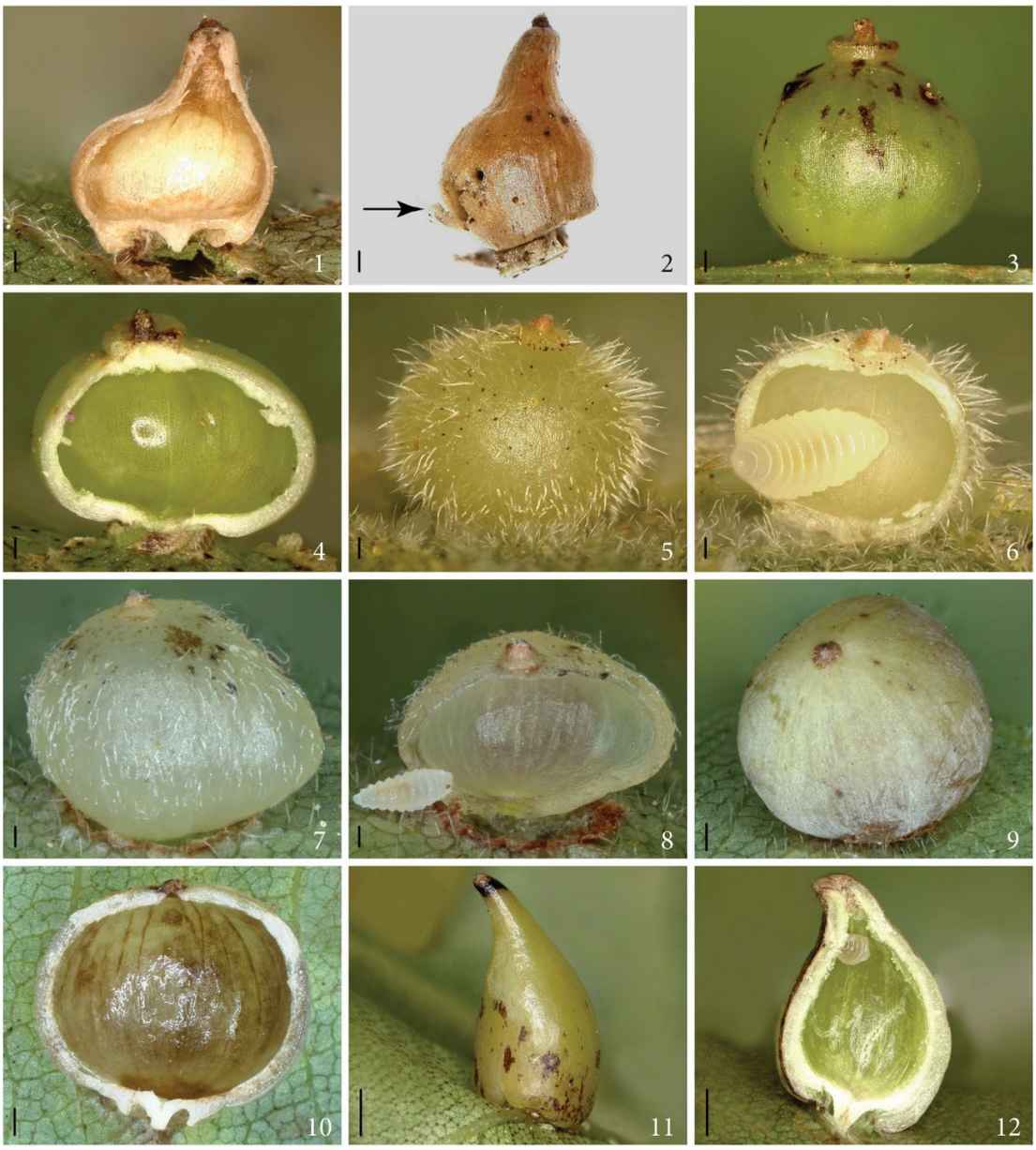


Plate 67. Juglandaceae. Galls of *Carya*. **1-12.** Galls of *Caryomyia* spp., entire or in longitudinal section. **1-2,** *C. shmoo*: **2,** arrow shows pupal exit on overwintered gall. **3-4,** *C. leviglobus*. **5-6,** *C. spiniglobus*: **6** with third instar. **7-8,** *C. deflexipili*: **8** with second instar. **9-10,** *C. glauciglobus*. **11-12,** *C. caryaecola*: **12** with second instar. Lines indicate approximate length of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

Plate 68. Juglandaceae. Galls of *Carya*. **1-12.** Galls of *Caryomyia* spp., entire or in longitudinal section. **1-2,** *C. subulata*. **3-6,** *C. tubicola*: **3,** young galls, some not yet erupted from basal collar; **6,** overwintered galls, one with pupal exit, the other with excavated area prepared by larva. **7-10**, *C. flaticrustum*: 10, overwintered galls, that on left with basal excavated areas prepared by larva; gall on right with completely collapsed corona. **11-12,** *C. melicrustum*. Lines indicate approximate length of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

Plate 69. Juglandaceae. Galls of *Carya*. **1-12.** Galls of *Caryomyia* spp., entire or in longitudinal section. **1-2,** *C. striolacrustum*. **3-4,** *C. levicrustum*. **5-6,** *C. eumaris*. **7-8**, *C. recurvata*: **8** with parasitoid larvae. **9-10**, *C. spinulosa*. **11-12,** *C. procumbens*. Lines indicate approximate length of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

Plate 70. Juglandaceae. Galls of *Carya*. **1-12.** Galls of *Caryomyia* spp., entire or in longitudinal section. **1-2,** *C. supina*. **3-4,** *C. inanis*: **4** with third instar. **5-6,** *C. asteris*. **7-8,** *C. inflata*. **9-10,** *C. tumida*. **11-12,** *C. lenta*. Lines indicate approximate length of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

Plate 71. Juglandaceae. Galls of *Carya*. **1-13.** Galls of *Caryomyia* spp., entire or in longitudinal section. **1-2,** *C. caminata*. **3-4**, *C. ovalis*. **5-8,** *C. thompsoni*: **5**, pair varying in hairiness; **6**, sparsely haired form; **7-8**, thickly haired form. **9-10**, *C. holotricha*. **11-12**, *C. tuberculata*: **12** with second instar. **13,** C. purpurea. Lines indicate approximate length of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

Plate 72. Juglandaceae. Galls of *Carya*. **1-12**. Galls of *Caryomyia* spp., entire or in longitudinal section. **1-2,** *C. purpurea*: **2** with second instar. **3-5**, *C. turbinata*. **6-9,** *C. persicoides*: **6-7,** spheroid form; **8-9,** conical form. **10-11,** *C. glebosa*. **12,** *C. turbanella*. Lines indicate approximate length of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

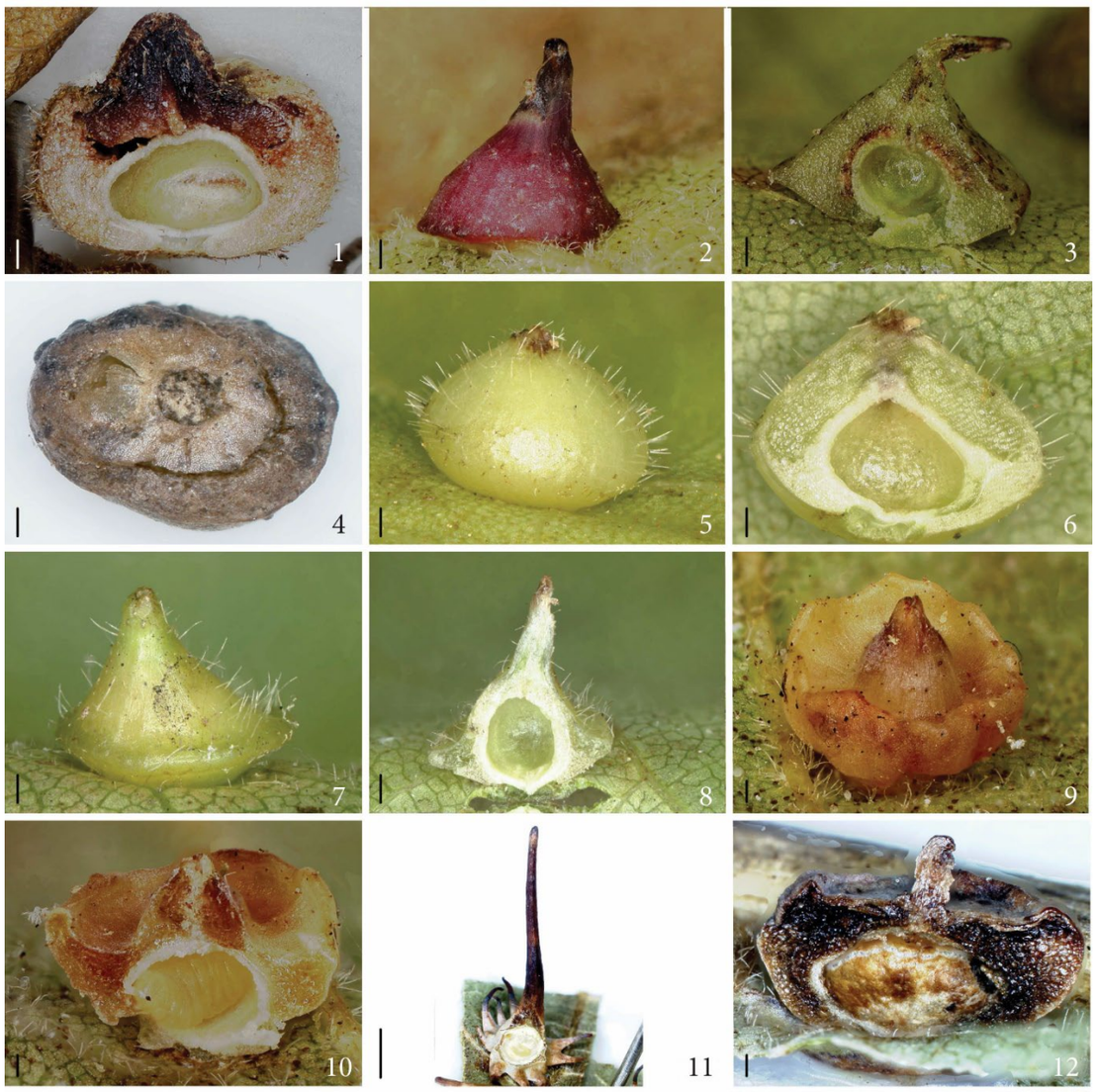


Plate 73. Juglandaceae. Galls of *Carya*. **1-12.** Galls of *Caryomyia* spp., entire or in longitudinal section. **1,** *C. turbanella*. **2-4,** *C. sanguinolenta*: **4,** base of overwintered gall showing pupal exit. **5-6,** *C. conoidea*. **7-8,** *C. marginata*. **9-10,** *C. arcuata*. **11,** *C. stellata*. **12,** *C. biretta*. Lines indicate approximate length of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

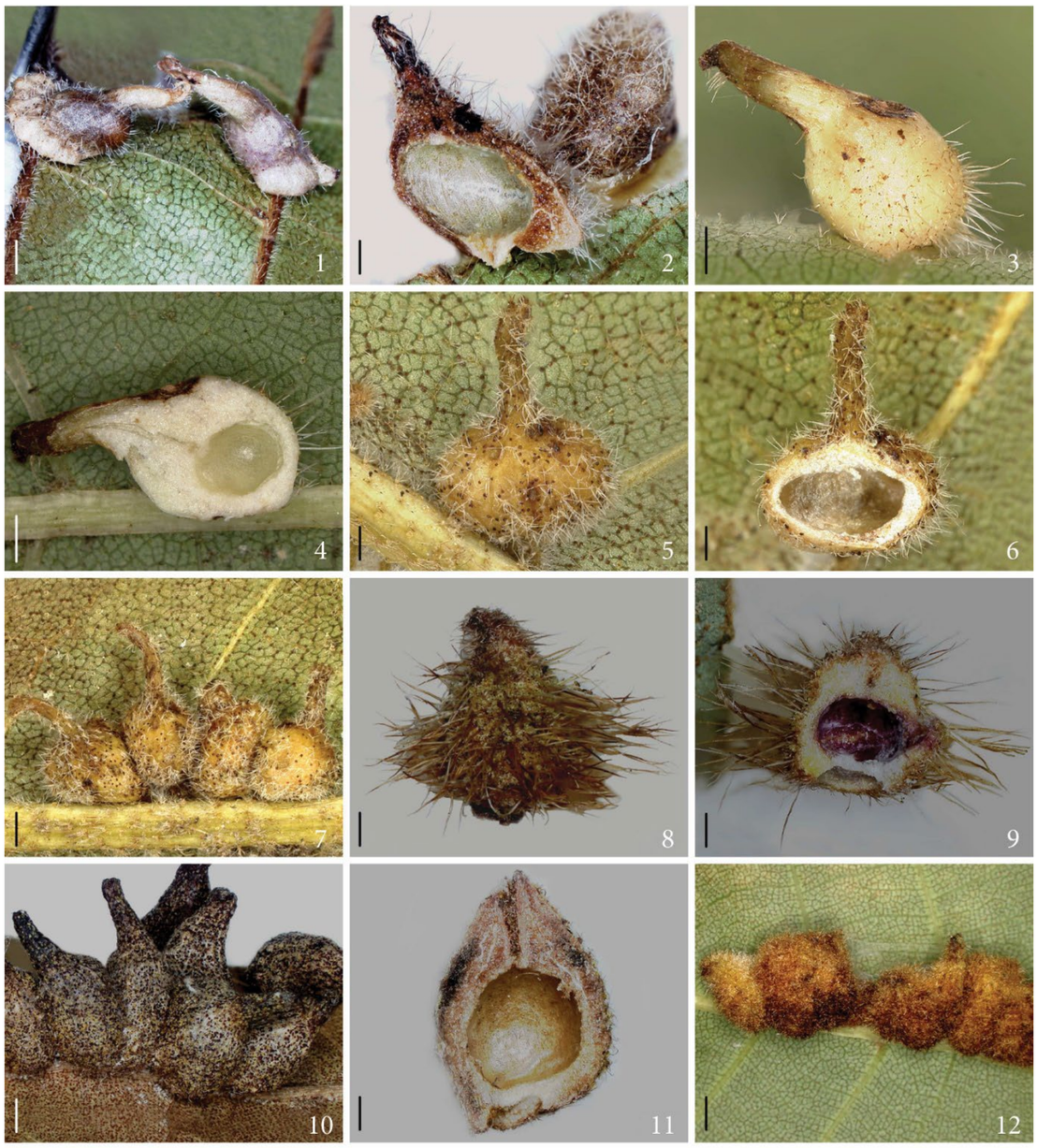


Plate 74. Juglandaceae. Galls of *Carya*. **1-12.** Galls of *Caryomyia* spp., entire or in longitudinal section. **1-2,** *C. inclinata*. **3-4,** *C. ansericollum*. **5-7,** *C. cucurbitata*. **8-9**, *C. echinata*. **10-11,** *C. guttata*. **12,** *C. aggregata*. Lines indicate approximate length of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

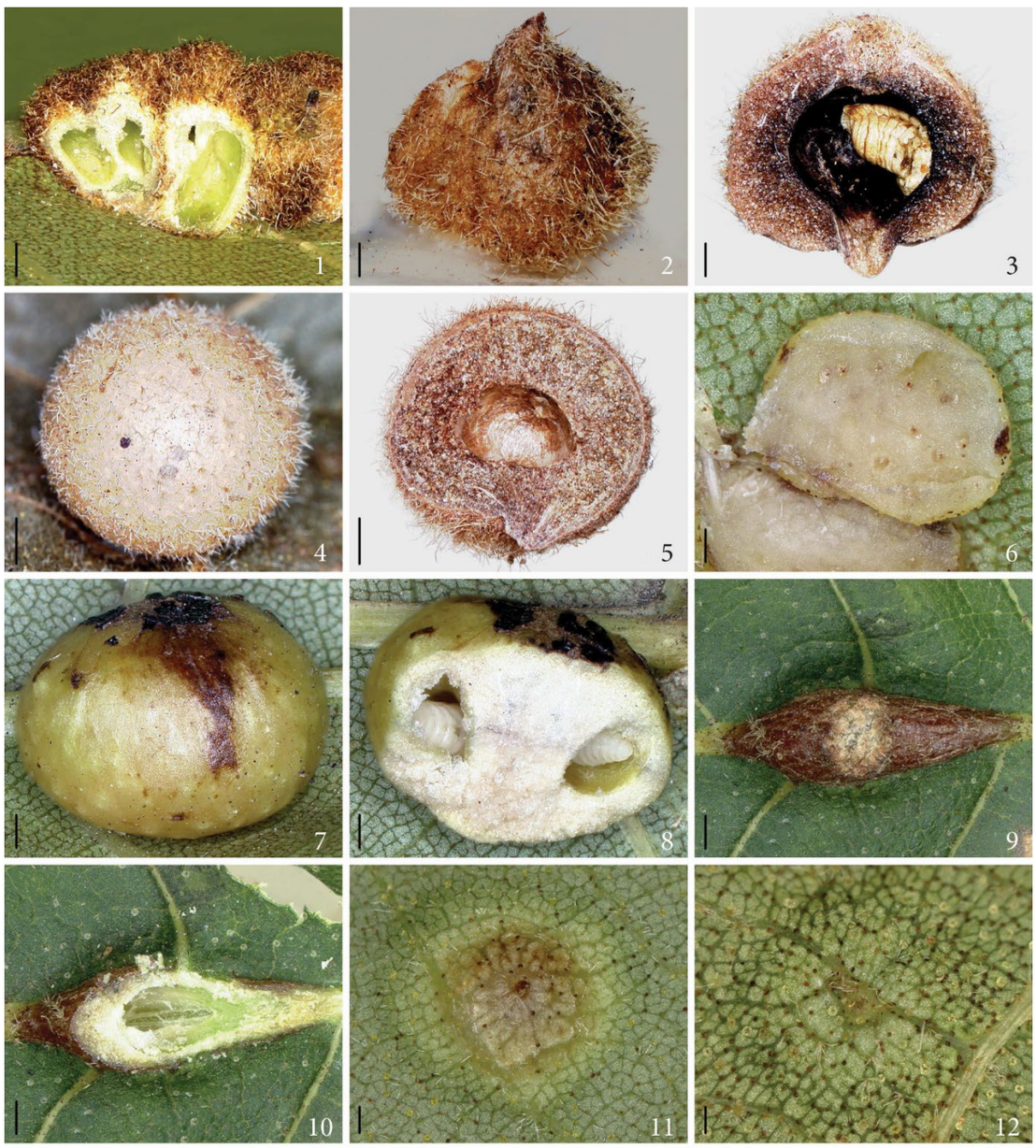


Plate 75. Juglandaceae. Galls of *Carya*. **1-8.** Galls of *Caryomyia* spp., entire or in longitudinal section. **1,** *C. aggregata*. **2-3,** *C. antennata*: **3** with third instar. **4-5,** *C. spherica*. **6-8,** *C. cynipsea*: **6,** young gall with several larval chambers; **8** with third instars in separate chambers. **9-12**. Galls of *Caryadiplosis* spp. **9-10,** *C. venicola*: **10,** sectioned. **11-12,** *C. biconvexa*: **11,** upper leaf surface; **12,** lower leaf surface. Lines indicate approximate length or diameter of mature galls. Gagné 2008

To 8 Gall Keys (Juglandaceae).

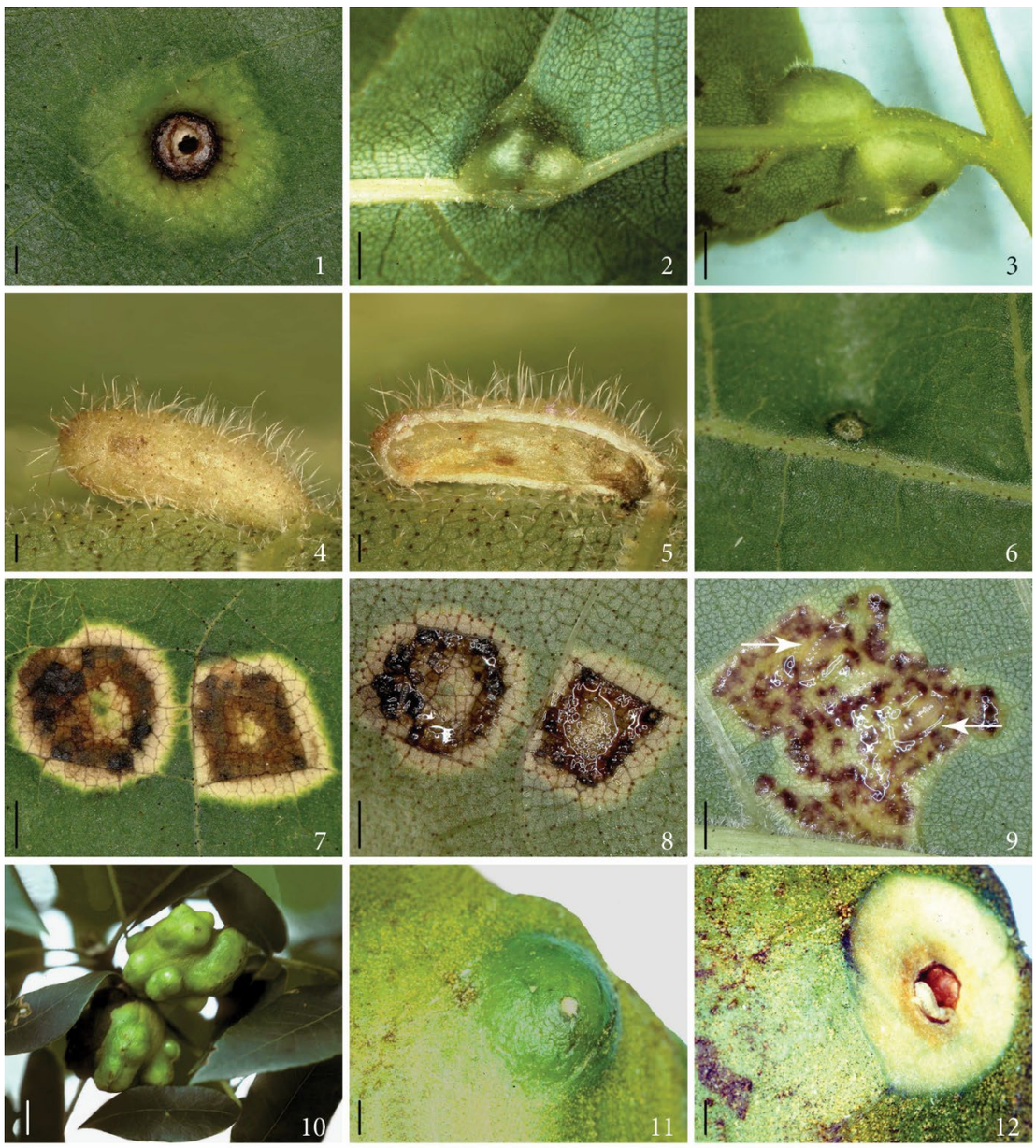


Plate 76. Juglandaceae. Galls of *Carya*. **1-12.** Galls entire or in section. 1, *Caryadiplosis biconvexa*, larval exit on upper leaf surface. **2-3,** *Contarinia bulliformis*. **4-6,** *Contarinia cucumata*: **6,** larval exit on upper leaf surface. **7-9,** *Gliaspilota glutinosa*: **7,** upper leaf surface; **8,** lower leaf surface; **9,** detail of lower surface, third instars indicated by arrows. **10-12,** *Harmandiola nucicola*. Lines indicate approximate length or diameter of mature galls. Gagné 2008.

To 8 Gall Keys (Juglandaceae).

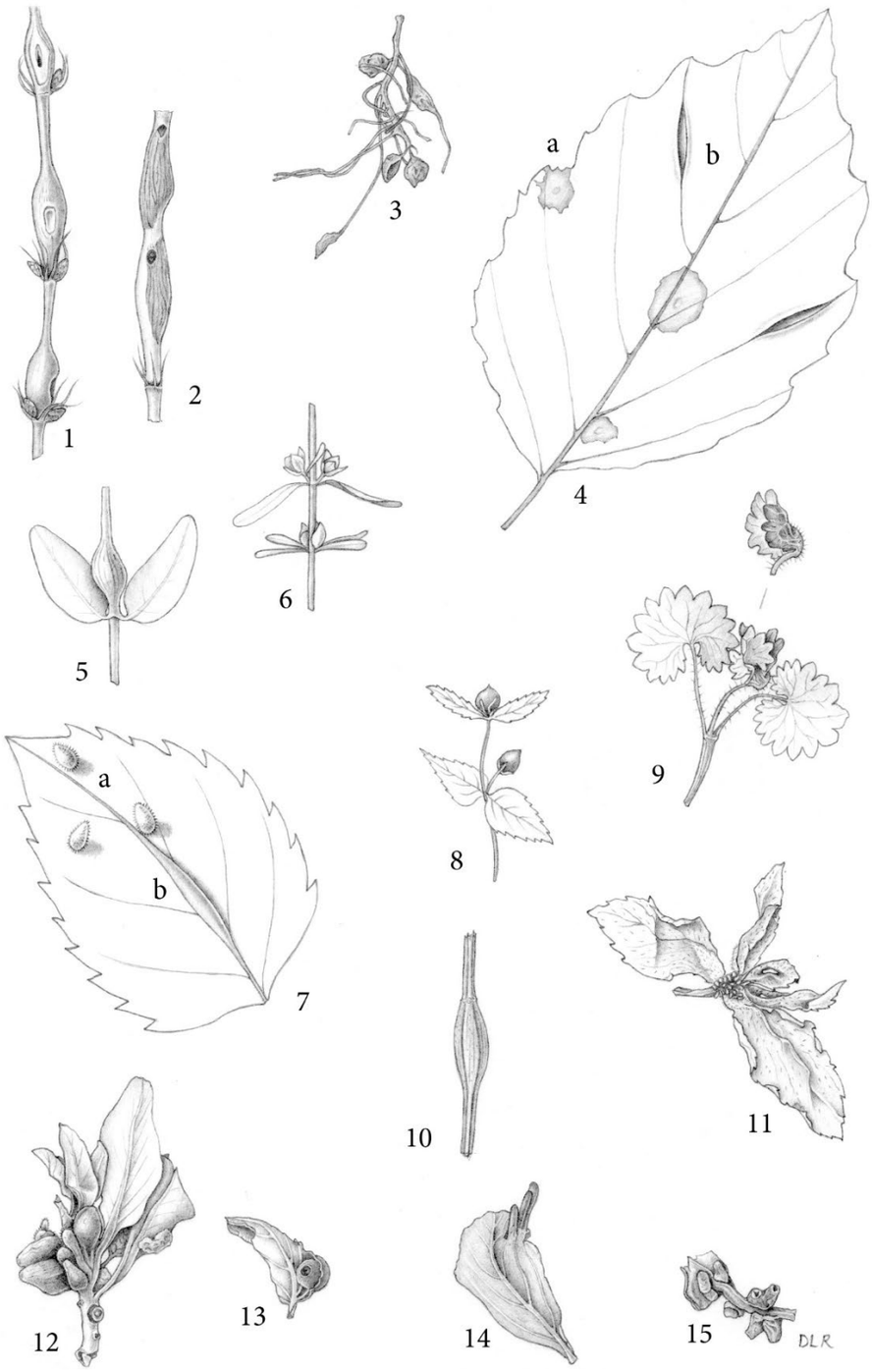


Plate 77. Celastraceae, Ephedraceae, Hamamelidaceae, Hypericaceae and Lamiaceae. **1,** Smooth, dimpled stem swellings, *Ephedra* sp.: *Lasioptera ephedrae*. **2,** Rough, resinous stem swellings, *Ephedra* sp.: *Lasioptera ephedricola*. **3,** Root nodules, *Hippocratea volubilis*: *Neolasioptera* sp. **4,** Leaf galls, *Hamamelis virginiana*: **a,** blister gall: *Contarinia* sp.; **b,** vein fold: cecidomyiid (redrawn from Wells 1914). **5,** Stem swelling, *Hypericum virginicum*: *Neolasioptera triadenii*. **6,** Swollen buds, *Hypericum perforatum*: *Zeuxidiplosis giardi* (after photograph in Given and Woods 1964). **7,** Leaf galls, *Collinsonia canadensis*: **a,** onion-shaped galls: *Dasineura collinsoniae*; **b,** swollen vein: *Lasioptera collinsonifolia*. **8,** Swollen buds (redrawn from Wells 1921b), *Cunila origanoides*: cecidomyiid. **9,** Vein fold, *Glechoma hederacea*: *Dasineura glechomae*. **10,** Stem swelling, *Monarda fistulosa*: *Neolasioptera monardi*. **11,** Vein folds, *Mentha arvensis*: *Dasineura aromaticae*. **12-15,** Tubular leaf and stem galls, *Salvia* spp.: *Rhopalomyia* spp. **12,** *S. apiana*: *R. audibertiae*. **13,** *S.* "*nivea*": *Rhopalomyia* sp. **14,** *S. apiana*: *Rhopalomyia salviae*. **15,** *S. apiana*: *R. audibertiae*. Gagné 1989.

To 8 Gall Keys (Celastraceae).
To 8 Gall Keys (Ephedraceae).
To 8 Gall Keys (Hamamelidaceae).
To 8 Gall Keys (Hypericaceae).
To 8 Gall Keys (Lamiaceae).

Plate 78. Lamiaceae. Galls of *Pycnanthemum tenuifolium*. **1,** Plant in flower. **2,** Rhizome galls: *Ametrodiplosis recondita*. **3,** Single gall of same. **4,** Same, interior with larva. **5,** Spherical stem gall: *Lasioptera lorrainae*. **6,** Same, interior with chambers and larvae. Gagné 2018.

To 8 Gall Keys (Lamiaceae).

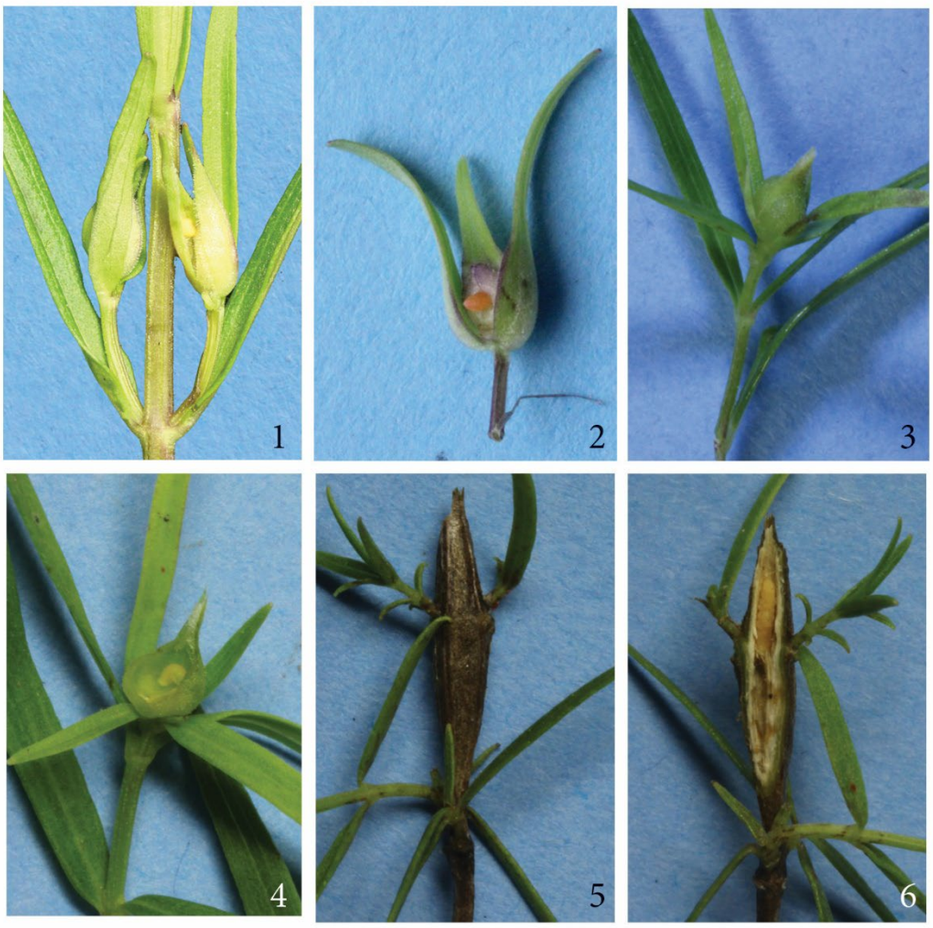


Plate 79. Lamiaceae. Galls of *Pycnanthemum tenuifolium*. **1.** Bud gall: *Dasineura laquerrarum*, one outer leaf removed. **2,** Same, one inner leaf removed to show nubbin and larva. **3,** Bud gall: *Ametrodiplosis geminata*. **4,** Same, interior with larva. **5,** Stem gall of *Neolasioptera truncata*. **6,** Same, interior with larva. Gagné 2018.

To 8 Gall Keys (Lamiaceae).

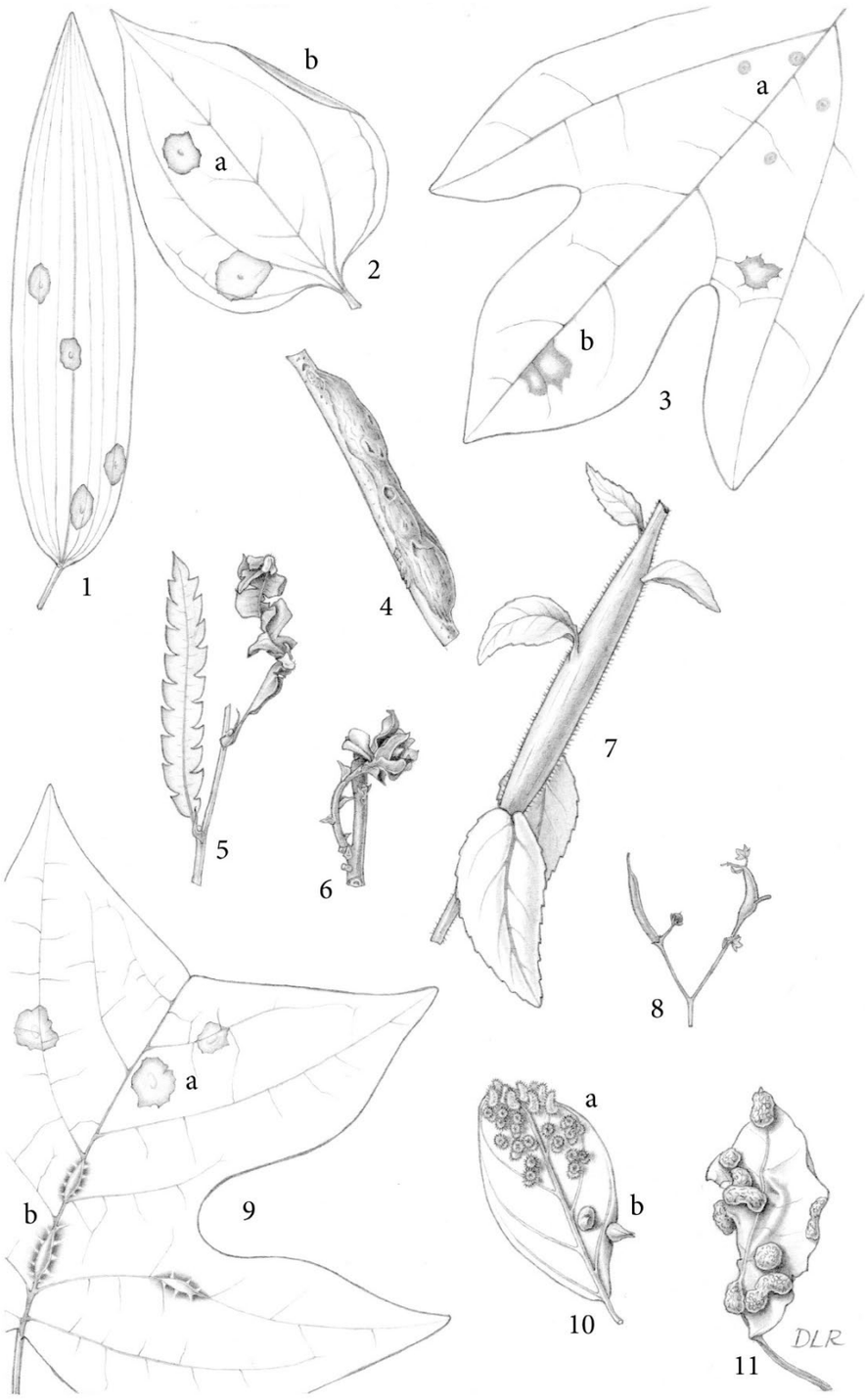


Plate 80. Asparagaceae, Campanulaceae, Lauraceae, Linaceae, Magnoliaceae, Myricaceae, Myrtaceae, Nyctaginaceae and Smilacaceae. **1,** Leaf spots, *Maianthemum racemosa*: cecidomyiid. **2,** Leaf galls, *Smilax* sp.: leaf spot: **a,** *Meunieriella* sp.; **b,** marginal leaf roll: *Dasineura smilacifolia*. **3,** Leaf spots, *Sassafras albidum*: **a,** with active larvae: *Contarinia* sp.; **b,** necrotic spots after larvae have escaped. **4,** Swollen stem, *Lindera benzoin*: *Neolasioptera linderae*. **5,** Leaf rolls, *Comptonia asplenifolia*: *Janetiella asplenifolia*. **6,** Swollen bud and rolled leaves, *Myrica cerifera*: *Prodiplosis myricae*. **7,** Swollen stem, *Lobelia puberula* (redrawn from Wells 1921a): *Neolasioptera* sp. **8,** Swollen stems, *Linum striatum*: *Neolasioptera* sp. **9,** Leaf galls (lower leaf surface), *Liriodendron tulipifera*: **a,** leaf spots: *Resseliella liriodendri*; **b,** swollen veins: *Resseliella tulipiferae*. **10,** Leaf galls, *Eugenia axillaris*: **a,** fuzzy, cylindrical galls: *Stephomyia eugeniae*; **b,** smooth, conical galls, *Stephomyia* sp. **11,** Woody leaf galls, *Pisonia subcordata*: *Bruggmannia* sp. Gagné 1989.

To 8 Gall Keys (Asparagaceae).
To 8 Gall Keys (Campanulaceae).
To 8 Gall Keys (Lauraceae).
To 8 Gall Keys (Linaceae).
To 8 Gall Keys (Magnoliaceae).
To 8 Gall Keys (Myricaceae).
To 8 Gall Keys (Myrtaceae).
To 8 Gall Keys (Nyctaginaceae).
To 8 Gall Keys (Smilacaceae).

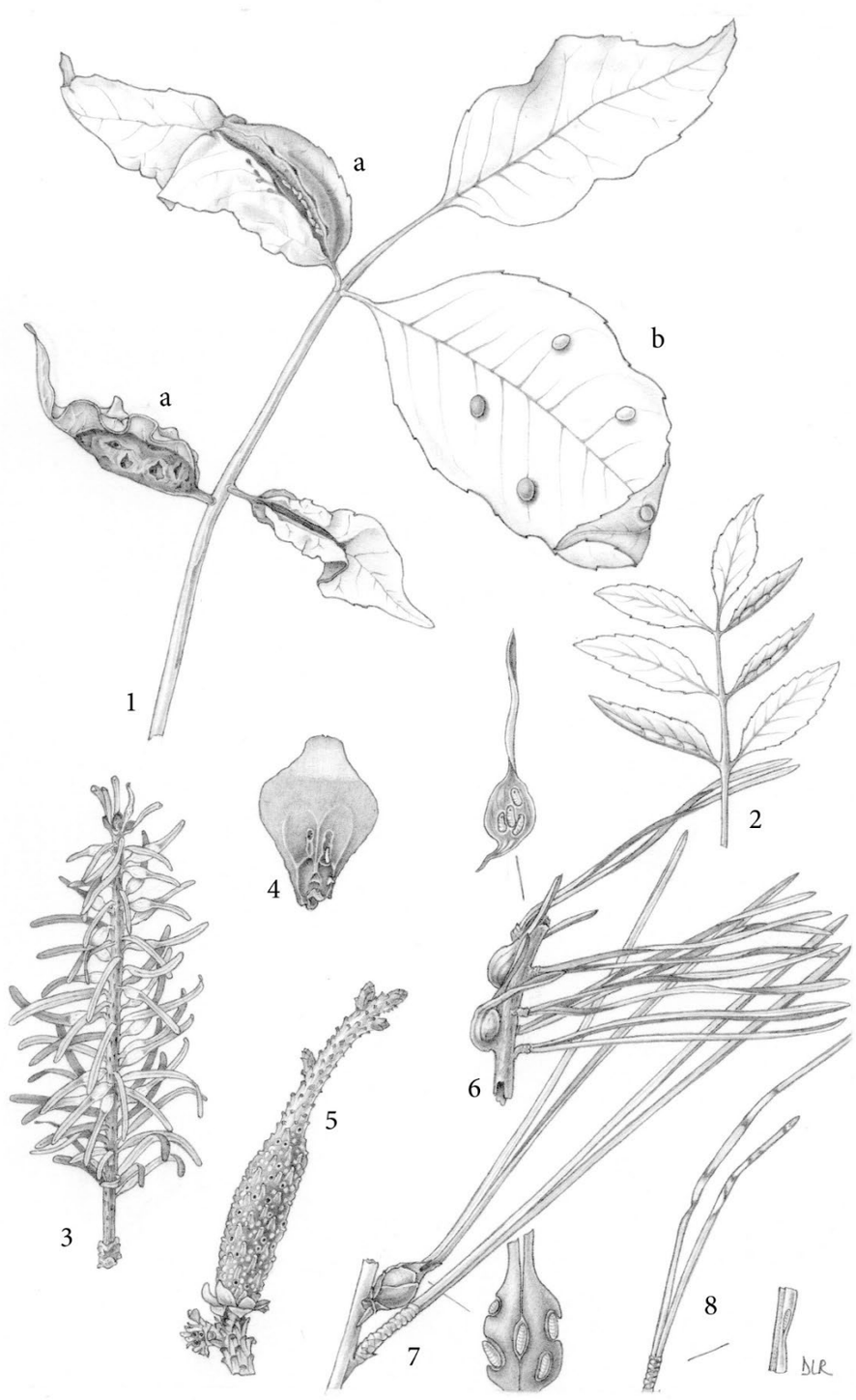


Plate 81. Oleaceae and Pinaceae. **1,** Leaf galls, *Fraxinus americana*: **a,** swollen midribs, one opened to show larvae: *Dasineura tumidosae*; **b**, pellet galls: *Dasineura pellex*. **2,** Folded leaflets, *Fraxinus americana*: *Dasineura apicata*. **3,** Needle swellings, *Abies balsamea*: *Paradiplosis tumifex*. **4,** Cone scale swellings, *Picea glauca*: *Kaltenbachiola canadensis*. **5,** Twig swellings, *Picea glauca*: *Piceacecis tsugae*. **6,** Swollen needles, with cross section in 2x to show larvae, *Pinus virginianae*: *Thecodiplosis brachynteroides*. **7,** Swollen base of needle, with sheath removed in 2x to show larvae, *Pinus resinosa*: *Thecodiplosis piniresinosae*. **8,** Brown-spotted needles, with larva on needle in 2x, *Pinus elliottii*: *Contarinia acuta*. Gagné 1989.

To 8 Gall Keys (Oleaceae).
To 8 Gall Keys (Pinaceae).

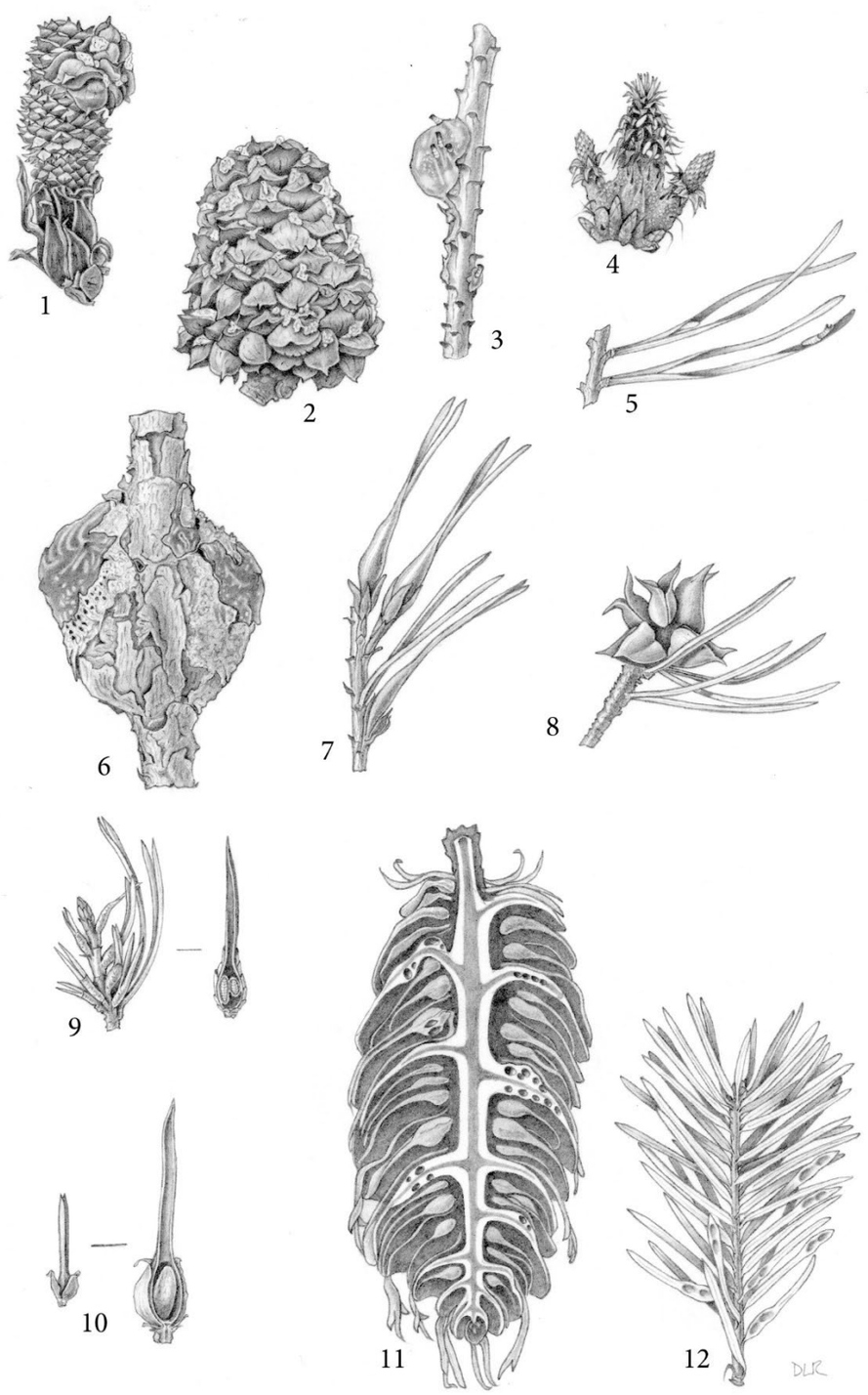


Plate 82. Pinaceae. **1, 2,** First- and second-year cones, respectively, *Pinus elliottii*: *Cecidomyia bisetosa*. **3,** Resin masses on twigs, with pupal exuviae, *Pinus virginiana*: *Cecidomyia resinicola*. **4,** Larval cocoons on buds, *Pinus taeda*: *Cecidomyia piniinopis*. **5,** Cocoons on needle, one with pupal exuviae, *Pinus virginiana*: *Cecidomyia piniinopis*. **6,** Swollen twig, *Pinus taeda*: *Cecidomyia reburrata*. **7-10,** Needle galls, *Pinus edulis*. **7,** *Pinyonia edulicola*. **8,** *Cembrotia* sp. **9,** With section in 2x: *Cembrotia* sp. **10,** With section in 2x: *Cembrotia coloradensis*. **11,** Cone (in longitudinal section) with scale swellings of *Pseudotsuga menziesii*.: Contarinia oregonensis. **12,** Needle swellings, *Pseudotsuga menziesii*: *Contarinia pseudotsugae*. Gagné 1989.

To 8 Gall Keys (Pinaceae).

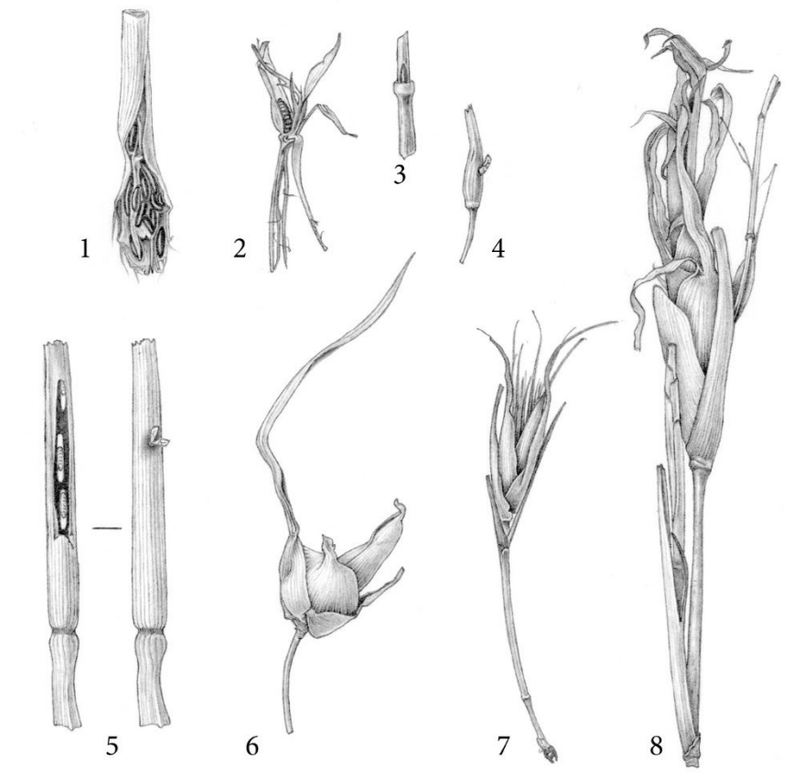


Plate 83. Poaceae. **1-4,** Stems of wheat, *Triticum aestivum*: *Mayetiola destructor*. **1,** Outer, basal leaves removed to show massed puparia. **2,** Puparium above node. **3,** Outer leaves removed, puparium in stem depression. **4,** Pupal exuviae in exit hole. **5,** Stems, *Spartina alterniflora*: *Calamomyia spartinae*: one in partial section to show larvae in silken tunnels among black fungal excrescence, the other with pupal exuviae in exit hole, a slight discoloration due to the fungus appearing around hole. **6-8,** Forshortened, enlarged culms of various grasses: **6,** *Paspalum distichum*: *Edestochilus allioides*. **7,** *Aristida gyrans*: *Chilophaga gyrantis*, **8,** *Muhlenbergia mexicana*: *Astictoneura muhlenbergiae*. Gagné 1989.

To 8 Gall Keys (Poaceae).

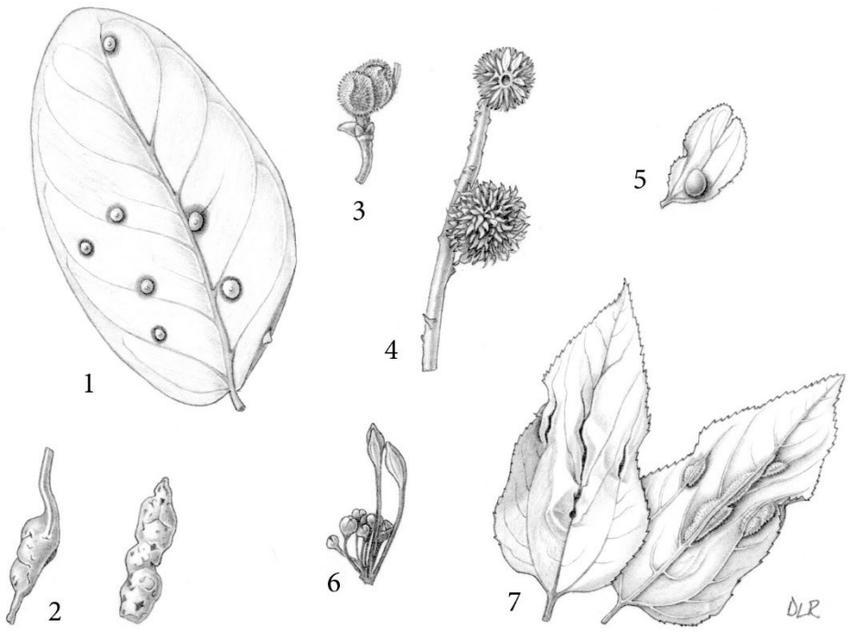


Plate 84. Orchidaceae, Polygonaceae and Rhamnaceae. **1,** Leaf blister galls, *Coccoloba diversifolia*: *Ctenodactylomyia watsoni*. **2,** Swollen, aerial rood nodules of orchid: *Neolasioptera* sp. **3-7,** Galls of Ceanothus. **3,** Swollen bud: *Asphondylia* sp. **4,** Leafy node gall, one in cross section., *Ceanothus velutinus*: *Asphondylia ceanothi*. **5,** Globular leaf gall: *Asphondylia* sp. **6,** Normal and pedicellate, galled flowers, *Ceanothus velutinus*: *Asphondylia* sp. **7,** Vein folds, *Ceanothus* sp.: *Contarinia* sp. Gagné 1989.

To 8 Gall Keys (Orchidaceae).
To 8 Gall Keys (Polygonaceae).
To 8 Gall Keys (Rhamnaceae).

Plate 85. Rosaceae. **1-4.** Galls of *Prunus* sp. **1,** Rachis swelling, *P. serotina*: *Contarinia racemi*. **2,** Normal and swollen fruit, one cut open to show larval chamber without stone, *P. serotina*: *Contarinia virginianae*. **3,** Swollen bud, *P. serotina*: *Contarinia cerasiserotinae*. **4,** Hard, leaf fold gall, one opened to show larvae, *P. angustifolia*: *Putoniella* sp. **5-7,** Galls of *Purshia tridentata*. **5,** Swollen flower receptacle with aborted seed in 2x: cecidomyiid. **6,** Normal receptacle in seed, **7,** Filamentous node gall, with section in 2x, *Purshia tridentata*: *Contarinia* sp. **8,** Leaf vein swelling, *Sorbus americana*: cecidomyiid. **9-12,** Galls of *Rosa* sp. **9,** Leafy bud gall: *Dasineura* sp. **10,** Aborted flower bud: *Dasineura rhodophaga*. **11,** Curled leaves: *Dasineura* sp. **12,** Fuzzy, convex leaf galls: *Blaesodiplosis* sp. **13,** Leaf vein swellings, *Holodiscus discolor*: *Dasineura* sp. Gagné 1989.

To 8 Gall Keys (Rosaceae).

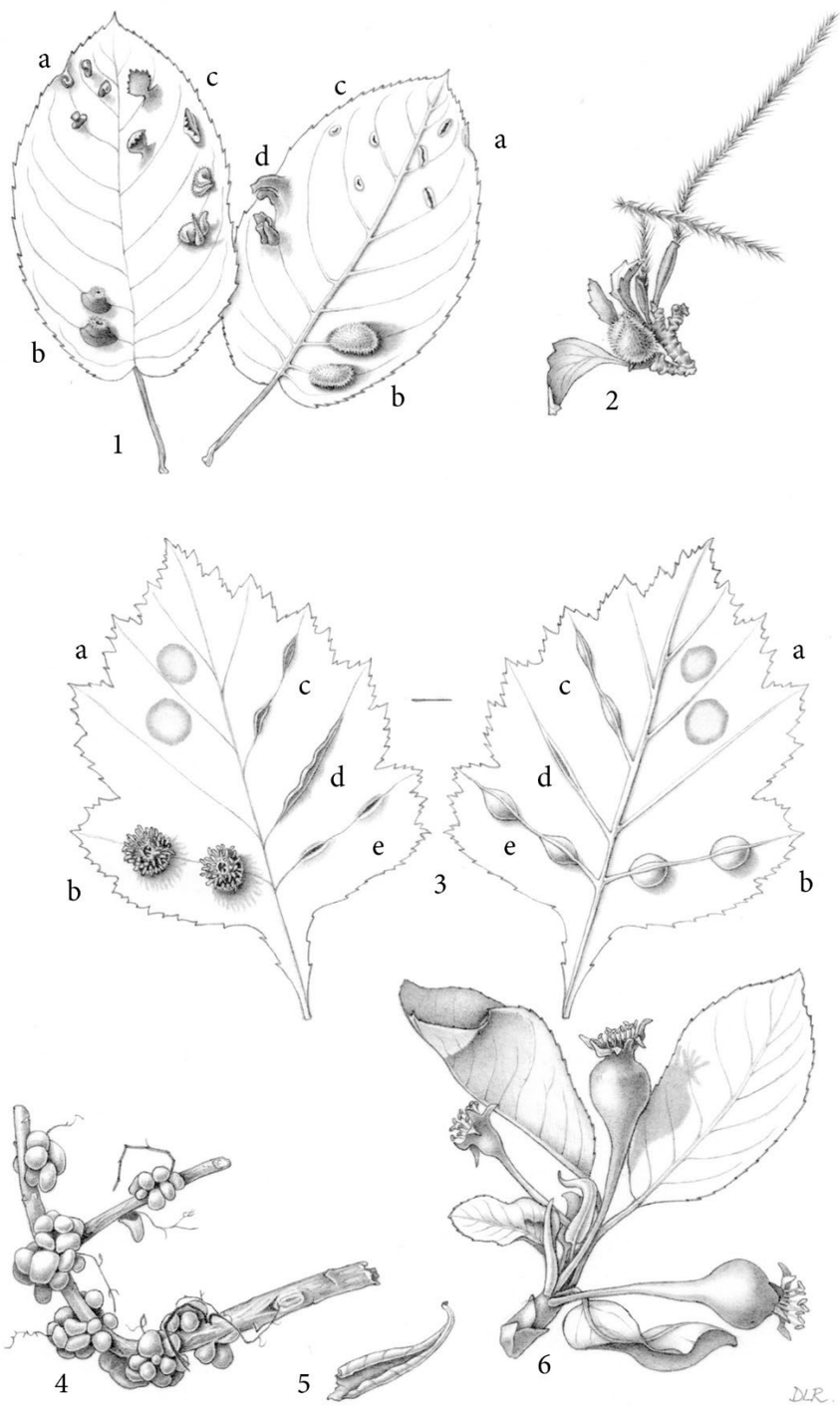


Plate 86 Rosaceae and Chrysobalanaeae. **1,** Leaf galls of *Amelanchier canadensis*, upper surface on left, lower on right: **a-c,** *Blaesodiplosis* spp,; **d,** *Blaesodiplosis canadensis*. **2.** Bud gall of *Cercocarpus* sp.: *Dasineura cercocarpi*. **3.** Leaf galls of *Crataegus* sp., upper surface on left, lower on right: **a,** leaf spots: *Lasioptera excavata*; **b,** fringed galls: *Dasineura crataegibedeguar*; **c,** *Blaesodiplosis* sp.; **d,** cockscomb gall: *Blaesodiplosis crataegifolia*; **e,** *Blaesodiplosis venae*. **4,** Subterranean galls, *Geobalanus oblongifolius*: cecidomyiid. **5-6**, Galls of pear, *Pyrus communis*. **5,** Curled leaf: *Dasineura pyri*. **6,** Enlarged, aborted fruitlets: *Contarinia pyrivora*. Gagné 1989.

To 8 Gall Keys (Chrysobalanaceae).
To 8 Gall Keys (Rosaceae).

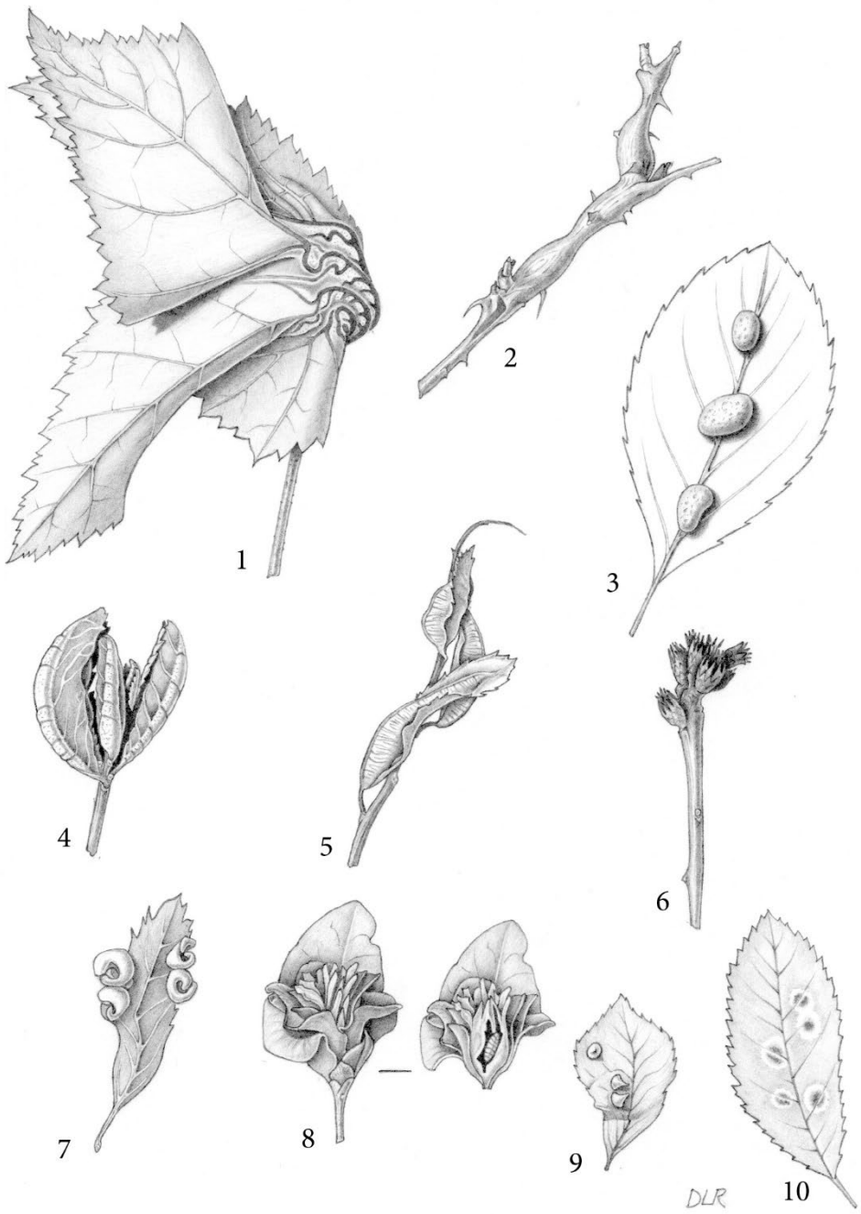


Plate 87. Rosaceae. **1-3,** Galls of Rubus spp. **1,** Folded veins, distorting leaf, *Rubus parviflorus*: *Dasineura* sp. **2,** Swollen stem, *Rubus* sp.: *Neolasioptera nodulosa*. **3,** Warty leaf galls, *Rubus* sp.: *Neolasioptera farinosa*. Galls of *Spiraea* sp. **4, 5,** Vein folds: *Dasineura salicifoliae*. **6,** Clustered, aborted buds, "*Cecidomyia*" *lappa*. **7,** Marginal leaf rolls: *Dasineura* sp. **8,** Leaf rosette galls, one sectioned with larva in central cell: *Contarinia* sp. **9,** Cone-shaped leaf galls: cecidomyiid. **10,** Circular, flat leaf galls: *Lasioptera spiraeafolia*. Gagné 1989.

To 8 Gall Keys (Rosaceae).

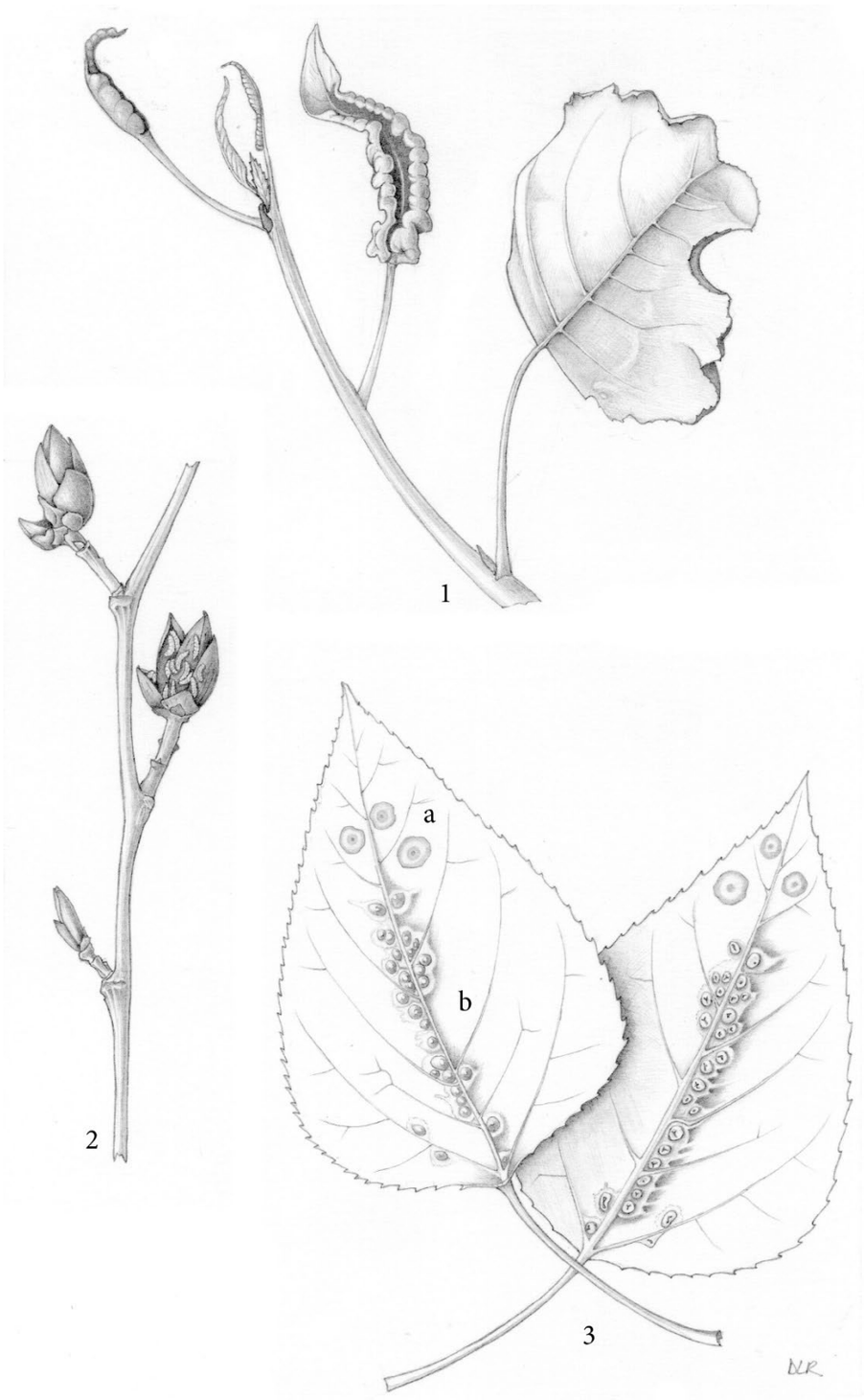


Plate 88. Salicaceae. Galls of *Populus* spp. **1,** Rolled leaves and curled leaf margins, *P. tremuloides*: *Prodiplosis morrisi*. **2,** Enlarged buds, scales removed from one to show larvae, *P. trichocarpa*: *Dasineura* sp. **3,** Leaf galls, upper leaf surface on left, lower on right, *Populus* sp.: **a,** slightly convex blister: *Contarinia* sp.; **b,** hemispherical galls: *Harmandiola helena*. Gagné 1989.

To 8 Gall Keys (Salicaceae).

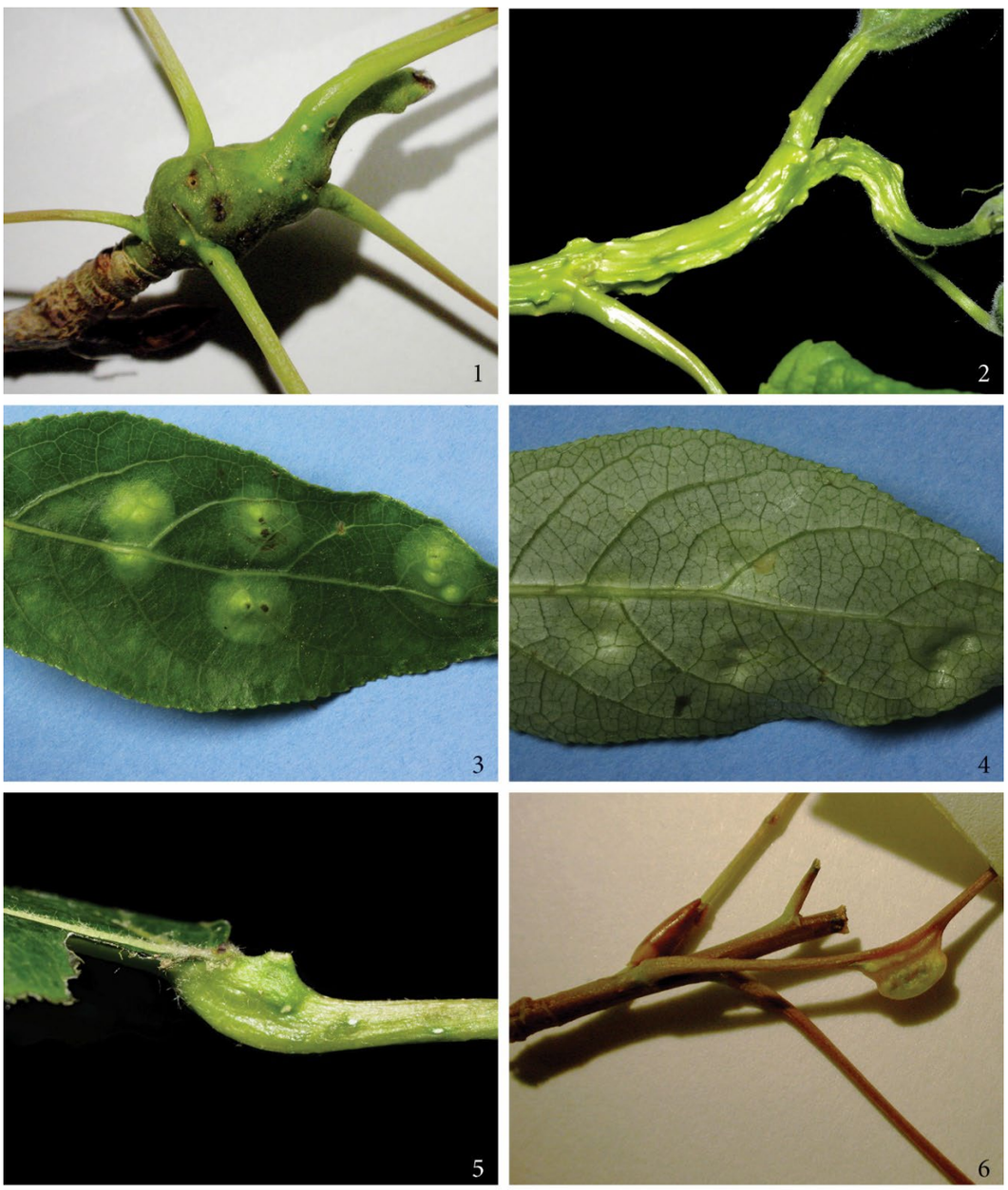


Plate 89. Salicaceae. Galls of *Populus* spp. **1,** Woody twig swelling: *Contarinia* sp. (T. Roslin). **2,** Twisted stem: *Contarinia* sp. (R. Russo). **3-4,** Leaf blister, upper and lower leaf surfaces, respectively: *Leucecis eminens* (R.J. Gagné). **5,** Hemispheroid, succulent, petiole gall: *Harmandiola* sp. (R. Russo). **6,** Elongate, hard petiole gall: *Harmandiola* sp. (T. Roslin).

To 8 Gall Keys (Salicaceae).

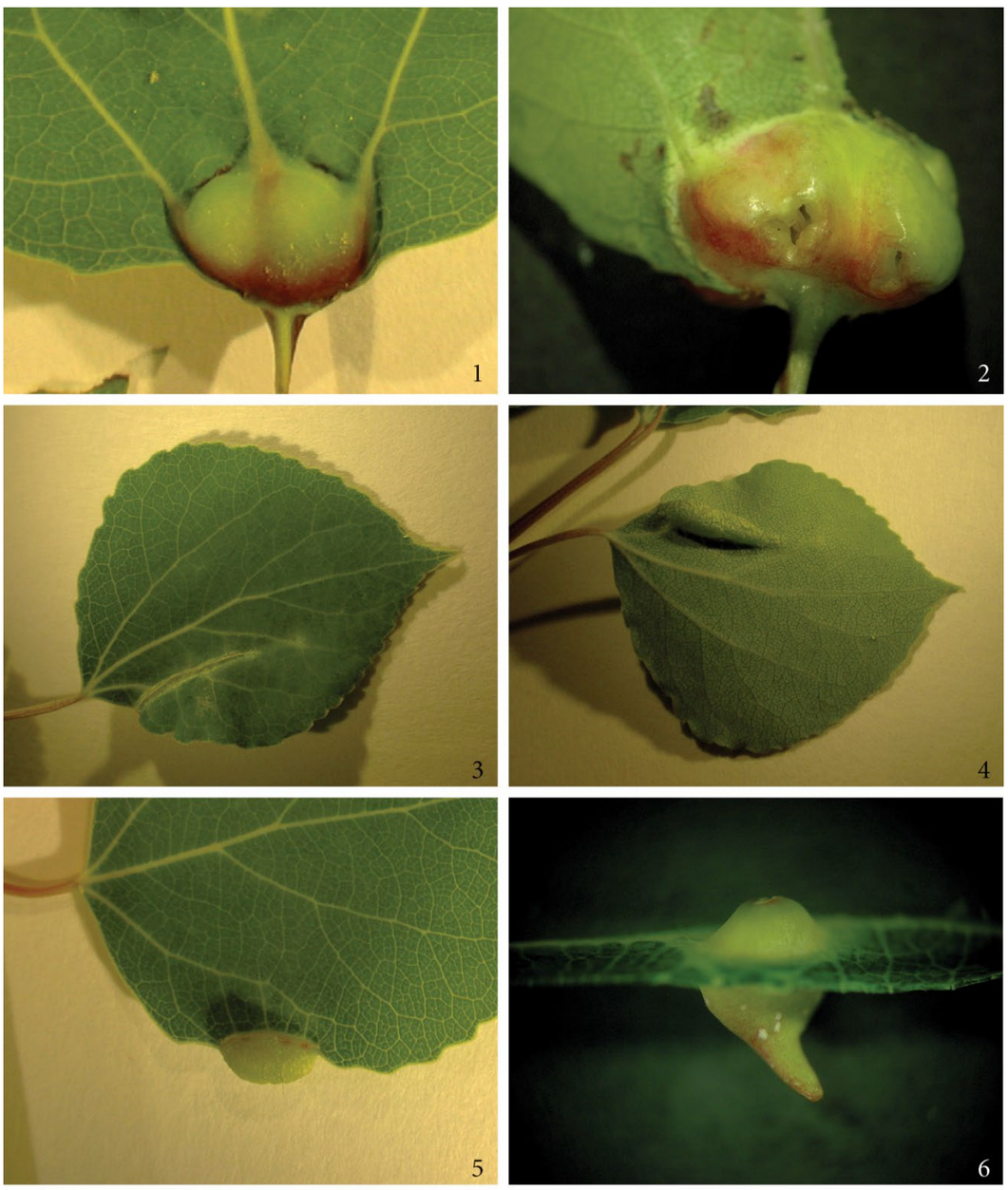


Plate 90. Salicaceae. Galls of *Populus tremuloides*: *Harmandiola* spp. **1-2,** Gall at junction of lamina and petiole, upper and lower surfaces, respectively. **3-4,** Long swelling crossing lamina, upper and lower surfaces, respectively. **5,** Leaf edge gall. **6,** Hemispheroid gall on upper leaf surface, pointed on lower surface. T. Roslin.

To 8 Gall Keys (Salicaceae).

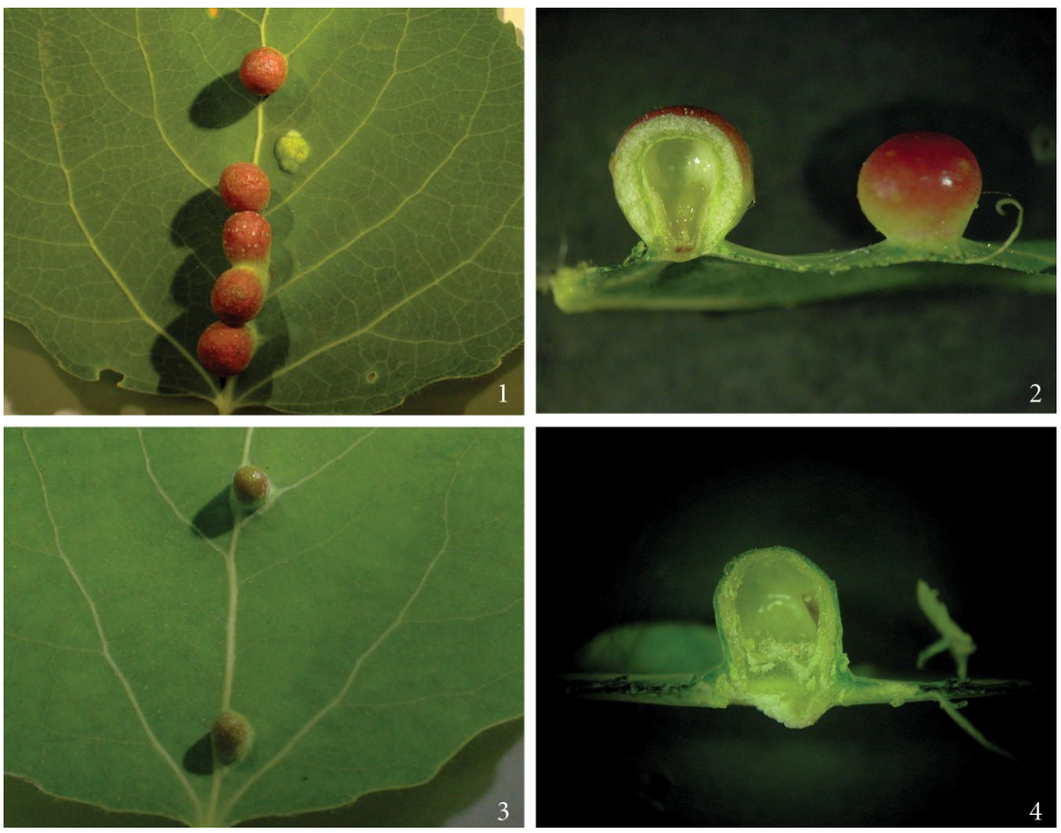


Plate 91. Salicaceae. Galls of *Populus tremuloides*, on upper surface of leaves only: *Harmandiola* spp. **1-2,** Gall ovate, thick-walled. **3-4,** Gall cylindrical, thin-walled. T. Roslin.

To 8 Gall Keys (Salicaceae).

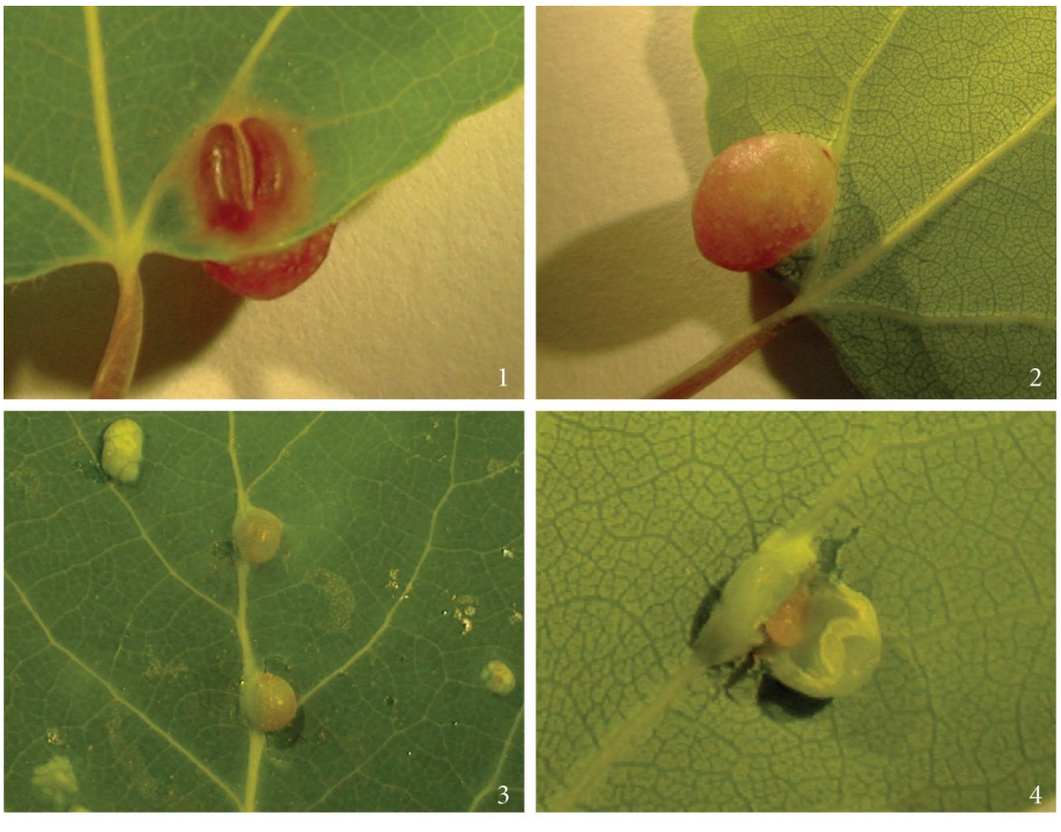


Plate 92. Salicaceae. Galls of *Populus tremuloides*, apparent on both sides of leaf: *Harmandiola* spp. **1-2,** Gall with lip-like swellings on upper leaf surface, spheroid on lower, respectively. **3-4,** Gall spheroid on upper leaf surface, spheroid but dimpled on lower, respectively. T. Roslin.

To 8 Gall Keys (Salicaceae).

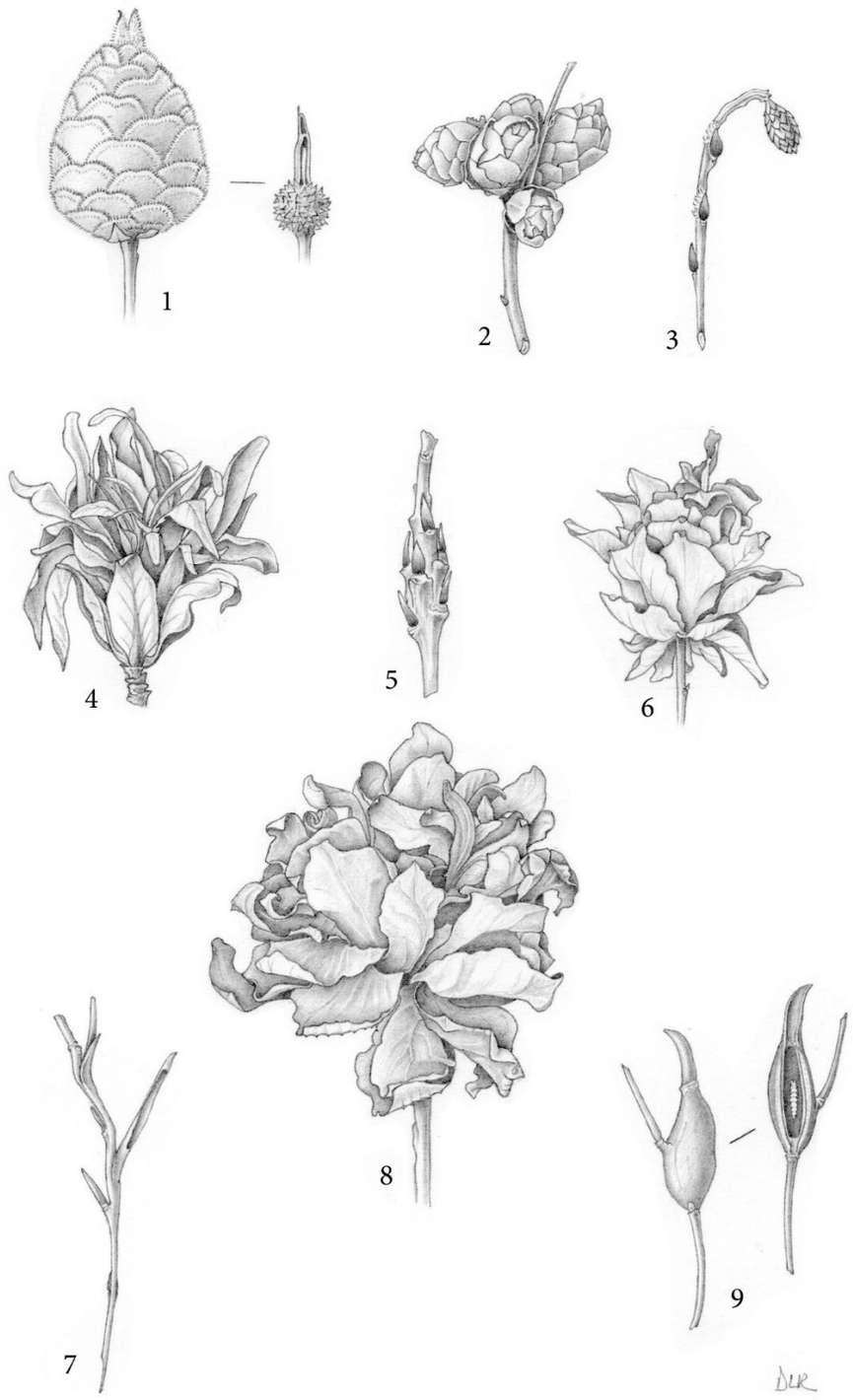


Plate 93. Galls of Salicaceae. *Salix* spp. All except **1** and **9** are drawn from galls in original type series. **1,** Terminal branch galls, one with leaves removed to show central larval cell: *Rabdophaga strobiloides*. **2,** Clustered, lateral branch galls possibly attributable to *R. strobiloides*. **3,** "Cone" gall with recurved stem: *Rabdophaga salicisgnaphaloides*. **4,** "Cabbage" gall: *Rabdophaga salicisbrassicoides*. **5,** Foreshortened, swollen stem: *Rabdophaga salicistriticoides*. **6,** "Rose" gall, *Rabdophaga salicisrhoidoides*. **7,** "Horn" galls: *Rabdophaga saliciscornu*. **8,** "Hazel" gall: *Rabdophaga saliciscoryloides*. **9,** "Beaked" galls, one in section: *Rabdophaga rigidae*. Gagné 1989.

To 8 Gall Keys (Salicaceae).

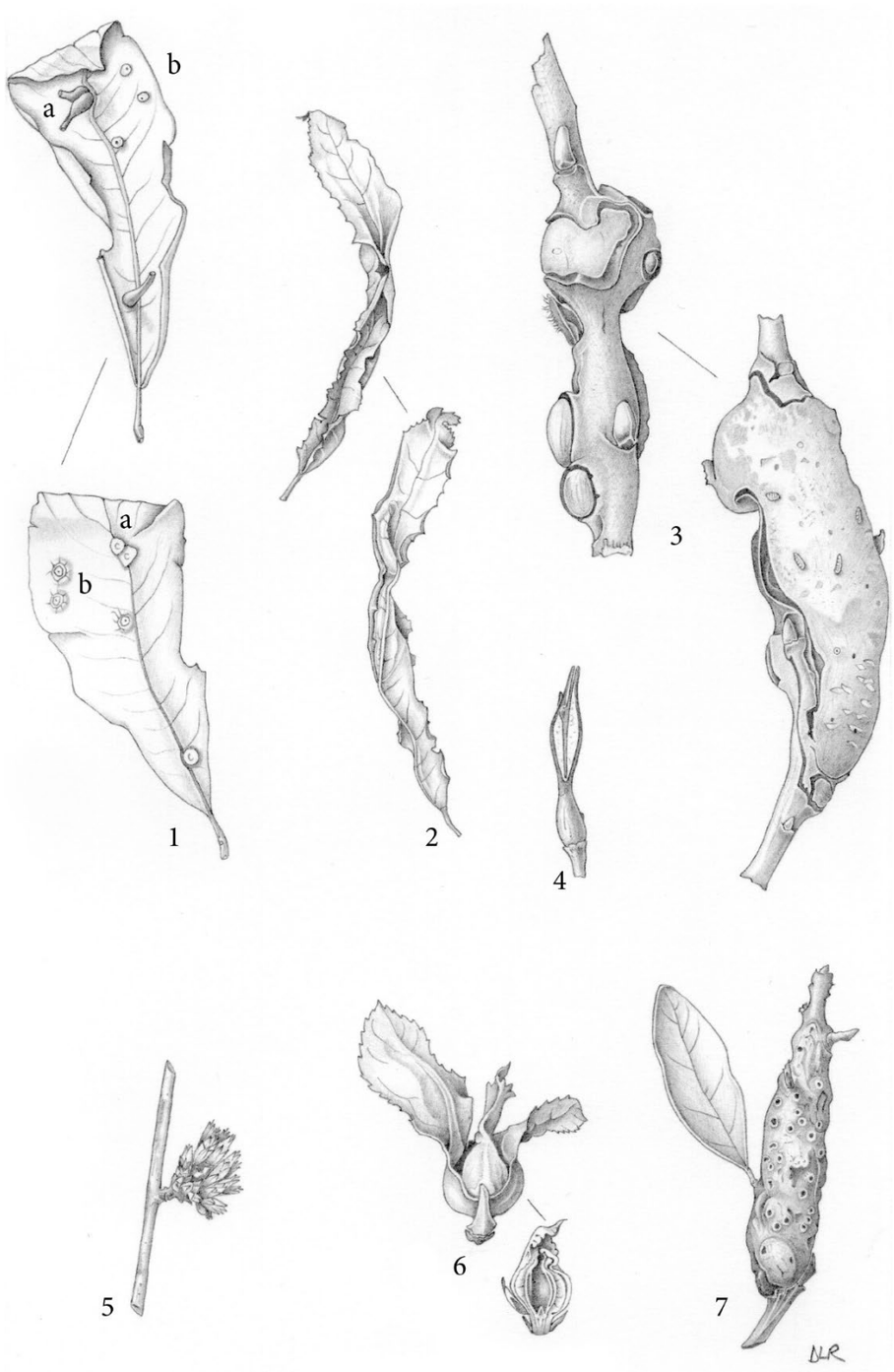


Plate 94. Galls of Salicaceae, Sapotaceae and Saxifragaceae. **1-4**, *Salix* spp. **1,** Leaf galls, lower leaf surface at top, upper at bottom: **a,** tube galls: *Iteomyia salicisverruca*; **b,** spherical galls: *Iteomyia salicifolia*. **2,** Leaf fold, upper leaf surface at top, lower at bottom: *Dasineura plicata*. **3,** Soft stem swelling: *Rabdophaga salicisbatatas*. **4,** Hard stem swelling, half in section: *Rabdophaga salicisnodulus*. **5,** Enlarged, deformed buds, *Ribes grossularia*: *Rhopalomyia grossulariae*. **6,** Swollen buds, one in section, *Hydrangea arborescens*: *Asphondylia hydrangeae*. **7,** Stem swelling with exit holes, *Sideroxylon lanuginosa*: *Bruggmanniella bumeliae*. Gagné 1989.

To 8 Gall Keys (Grossulariaceae).
To 8 Gall Keys (Hydrangeaceae).
To 8 Gall Keys (Salicaceae).
To 8 Gall Keys (Sapotaceae).

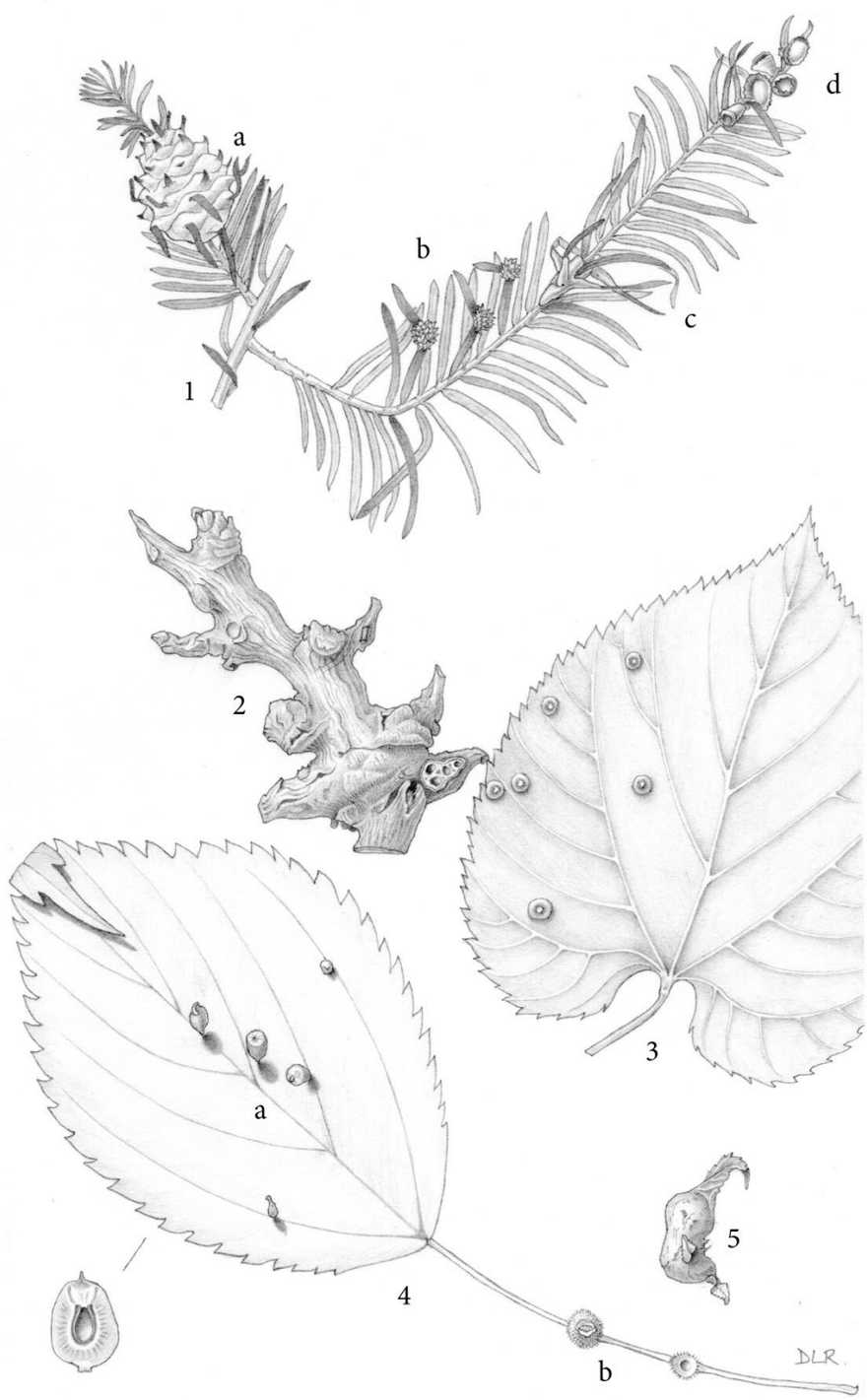


Plate 95. Cupressaceae, Malvaceae and Urticaceae. **1,** Branchlet and needle galls, *Taxodium distichum*: *Taxodiomyia* spp.: **a,** branchlet gall: *T. cupressiananassa*; **b,** starburst needle galls: *Taxodiomyia* sp.; **c,** sausage-like needle galls: *T. taxodii*; **d,** obconic needle galls: *Taxodiomyia* sp. **2,** Swollen twig, one part sectioned to show larval cells, *Tilia americana*: *Contarinia citrina*. **3,** Warty leaf gall, *Tilia americana*: *Contarinia verruccicola*. **4,** Leaf galls, *Laportea canadensis*: **a,** conical, nippled galls of various ages, one sectioned in 2x: *Dasineura investita*. **b,** fuzzy spherical gall, one showing socket only: *Dasineura pilosa*. **5,** Amorphous leaf gall, *Laportea canadensis*: *Dasineura involuta*. Gagné 1989.

To 4 Synopsis.
To 8 Gall Keys (Cupressaceae).
To 8 Gall Keys (Malvaceae).
To 8 Gall Keys (Urticaceae).

Plate 96. Cupressaceae. Galls of *Taxodium distichum*: *Taxodiomyia* spp. 1, Pineapple gall, *Taxodiomyia cupressiananassa*. 2, Cluster gall. 3, Sausage gall, *Taxodiomyia taxodii*. 4, Blister gall. 5, Cup and saucer gall, *Taxodiomyia cupressi*. 6, White starburst gall. R.J. Gagné.

To 4 Synopsis.
To 8 Gall Keys (Cupressaceae).

Plate 97. Cupressaceae. Galls of *Taxodium distichum*: *Taxodiomyia* spp. 1, Fringed gall. 2, Pea gall. 3, Two-horned gall. 4, Yellow starburst gall. 5, Medusa gall. 6, Bow-tie gall. (1, 3-4, 6, R.J. Gagné; 2, 5, R.A. Thomas).

To 4 Synopsis.
To 8 Gall Keys (Cupressaceae).

Plate 98. Ulmaceae. Galls of *Ulmus* spp. **1,** Buds, *U. americana*: **a,** swollen leaf buds, one in 2x with larva exposed: *Dasineura ulmea*; **b,** eggs at base of flower bud: *Dasineura porrecta*. **2,** Malformed samaras, two in 2x, *U. americana*: *Dasineura porrecta*. **3,** Vein swelling, *U. americana*: *Janetiella ulmii*. **4,** Swollen branch bud, *U. rubra*: *Dasineura* sp. Gagné 1989.

To 8 Gall Keys (Ulmaceae).

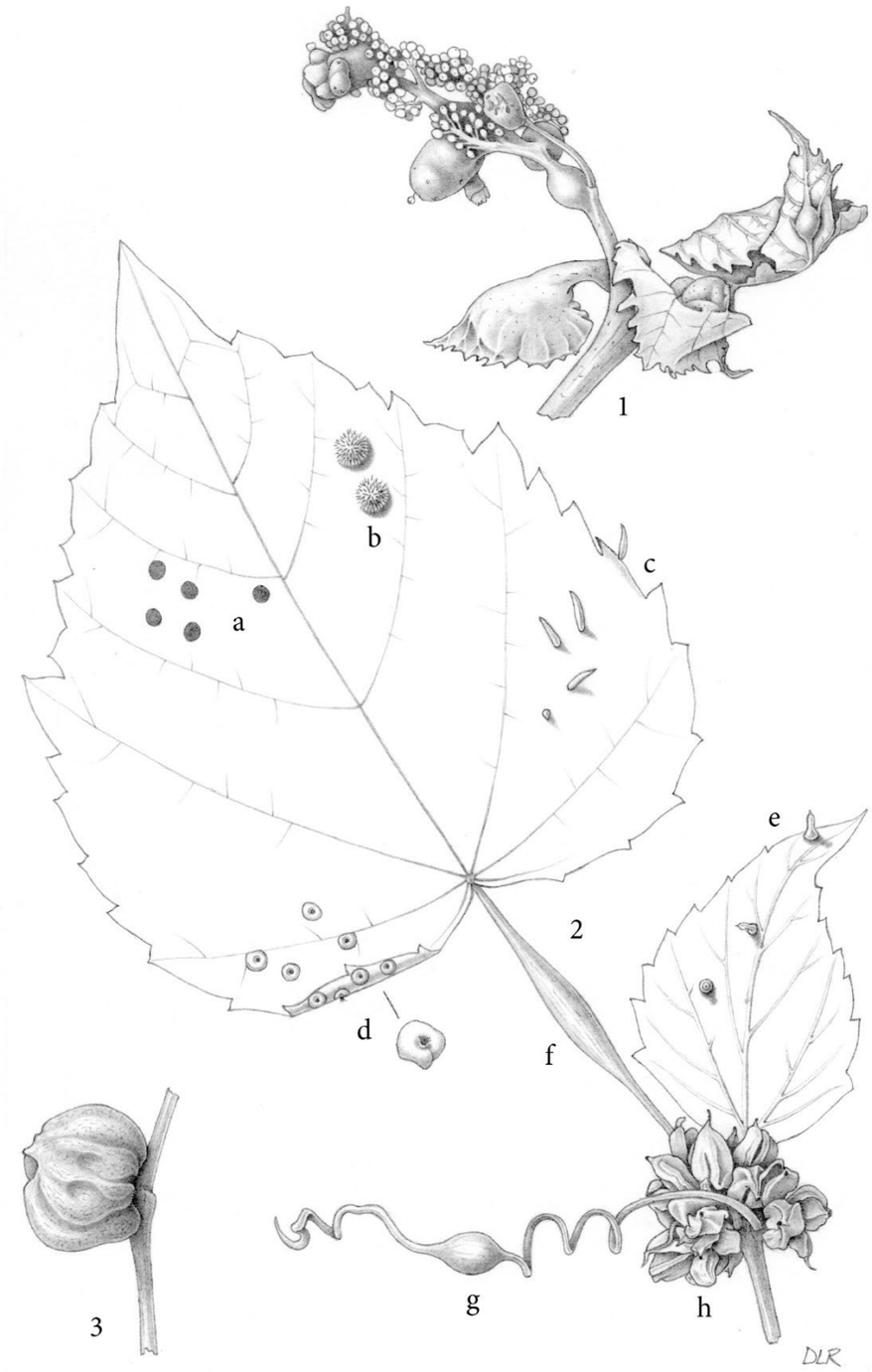


Plate 99. Vitaceae. Galls of *Vitis* spp. 1, Amorphous, succulent swellings on inflorescence and leaves: *Vitisiella brevicauda*. 2, Leaves and tendril: **a,** black spot galls: *Vitisiella* sp.; **b,** hairy, blister galls: *Vitisiella* sp.; **c,** woody, spinelike galls: *Ampelomyia viticola*; **d,** blister galls with hairy dimple, one in 2x: *Janetiella* sp.; **e,** woody spinelike gall: *Ampelomyia* sp.; **f, g,** woody petiole and tendril swelling, respectively: *Neolasioptera vitinea*; **h,** woody "hazelnut" node gall: *Ampelomyia vitiscoryloides*. 3, Woody "apple" node gall: *Ampelomyia vitispomum*. Gagné 1989.

To 8 Gall Keys (Vitaceae).

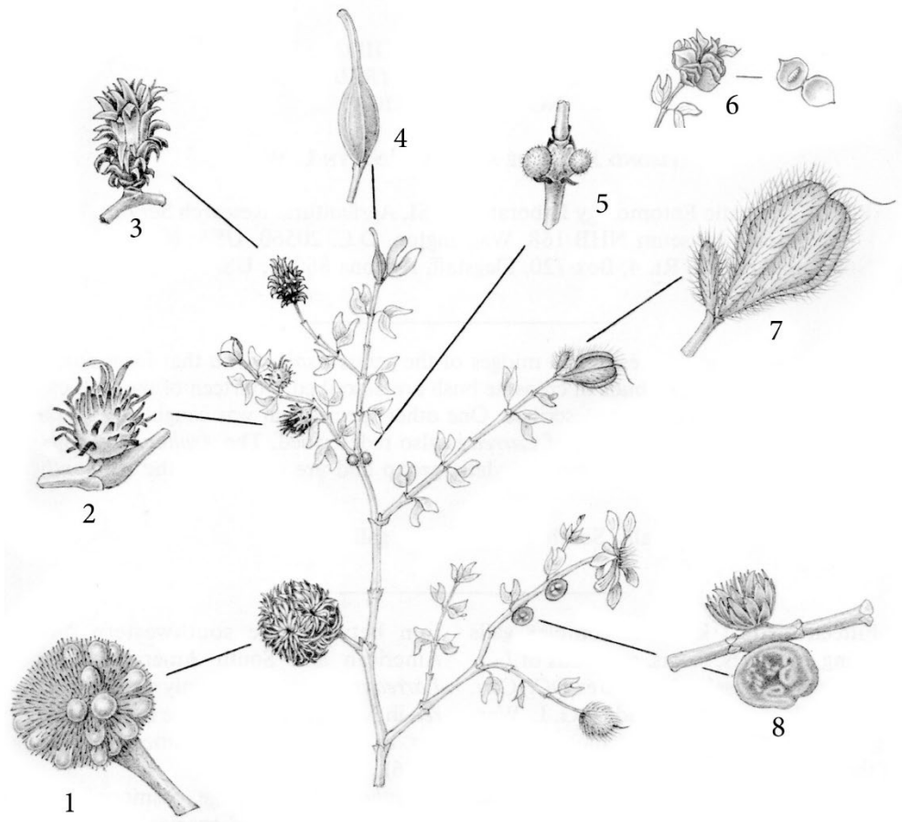


Plate 100. Zygophyllaceae. Stem and bud galls of *Larrea tridentata* formed by *Asphondylia* spp. and a *Contarinia* sp. Sprig of plant in 1x, details of galls in 3x. **1,** Stem gall, *A. auripila*, detail with outer leaves removed to show individual chambers beneath. **2,** Stem gall, *A. foliosa*; **3,** Stem gall, *A. rosetta*; **4,** Apical bud gall, *A. apicata*; **5,** Node galls, *A. bullata*; **6,** Circular, appressed pair of leaves at branch tip, *Contarinia* sp. **7,** Flower gall, *A. florea*; **8,** Stem galls, *A. resinosa*, covering resin removed from one of detailed pair. Gagné and Waring 1990.

To 8 Gall Keys (Zygophyllaceae).

Plate 101. Zygophyllaceae. Leaf galls of *Larrea tridentata* formed by *Asphondylia* spp. Sprig of plant in 1x, details of galls in 3x. 1, *A. barbata*. **2,** *A. villosa*. **3,** *A. discalis*. **4,** *A. silicula*. **5,** *A. pilosa*. **6,** *A. fabalis*; **7,** *A. clavata*. **8,** *A. digitata*. Gagné and Waring 1990.

To 8 Gall Keys (Zygophyllaceae).